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I. BANCSI, I. FODOR, I. KISS, A. SZITÓ, I BENEDECZKY, M. OBRADOVIĆ

REDIGIT

GY. BODROGKÖZY

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SZEGED, 1984

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STUDY ON THE HEAVY METALS HAVING EFFECT ON THE WATER BIOCENOSES IN THE BACKWATERS AT ALPÁR AND LAKITELEK

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Abstract

The heavy metals having effect on the water biocenosis were determined monthly during the course of 1982, in the backwaters of Alpár and Lakitelek. The studies involved the determination of the copper-, cadmium-, zinc-, chromium- and mercury-contents in the water. Apart from studying the heavy metals, the organic matter-content in the backwaters was also determined and the development of the ammonium- and nitrateconcentrations was followe a with attention. The pH of the water as well as the sodium- and potassium-contents were determined joint with the studies of the heavy metals. Correlations were observable between the zinc- and copper-contents and the amount of organisms in the waters. It could be determined that the two backwaters have significant mercury-content referring to external pollution.

Introduction

During the past three decades the rapid development of technology called for the increase of the exploitation, processing and utilization of the various heavy metals and this simultaneously meant the concentrated return of the heavy metals into our environment.

Despite the fact that the amount in question is relatively low, the reaction of the environment to the heavy metals appears in an increased degree in many cases. These substances cannot be decomposed, in many occasions they reappear in the environment, incorporated in the aliment-chain, possibly in technical reutilization.

It is also known since several decades that certain heavy metals are necessary for the living world in small amounts. There are also such heavy metals besides those needed for vital processes, the lack of which is not followed by consequences. The heavy metals extraneous for the living organism are definitely toxic (LITERÁTHY 1982).

In general, the various specifications mention the importance of 19 heavy metals in the human environment. From these, nine — boron, zinc, cobalt, chromium, manganese, molybdenum, tin, copper and iron — can be listed among the essential elements. Arsenic, beryllium, silver, mercury, cadmium and lead are explicitly toxic heavy metals (National Research Council 1977).

The heavy metals occurring in surface waters may be present in various forms in the waters and the toxic effects of these forms also vary.

The decomposition and equillibrium with organic matter production (photosynthesis) of the — firstly organic — contamination substances entering into the water is the condition of healthy water life. The heavy metals entering the water may hinder both processes, which may lead to the disintegration of the equillibrium or to the decay of the complete water organisms.

The various forms of heavy metals present in the water may undergo transformation, through which a previously less toxic form might become strongly toxic. Therefore, when studying heavy metals, the chemical parameters influencing the afore-mentioned forms must be taken into account in every case (CAMBLE—SCHNITZER 1973, PICKERING 1980, STUMM—MORGAN 1970).

During the course of our studies the essential heavy metals (copper, zinc, iron, manganese) were divided into a separate group, as were the toxic ones, too (mercury, cadmium, chromium).

Copper is the constituent of the enzymes conducting the important physiological functions. Certain algal species are extremely sensitive against copper, moreover, even a low concentration of copper proves to be toxic in the case of the Spirogyra species (LITERÁTHY 1982, PÉTERFI 1977).

Zinc is an essential element of low toxicity, playing an extremely important role in photosynthesis and respiration. The equillibrium concentration of the bottom sediment and water is highly sensitive to the change in pH.

Iron has an important role in the structure of the respiratory enzymes, the nitrogenase enzymes participating in the photosynthesis and catalyzing the binding of ferrodoxin and the molecular nitrogen (PÉTERFI 1977).

Manganese is of importance regarding the functioning of the oxidases. Its hydroxide, with the binding of other toxic heavy metals, displays significant effect.

Mercury is a typically non-essential element. Due to its strong toxic effect it has become general as germicidal and fungicidal agent in medicine and agriculture. The

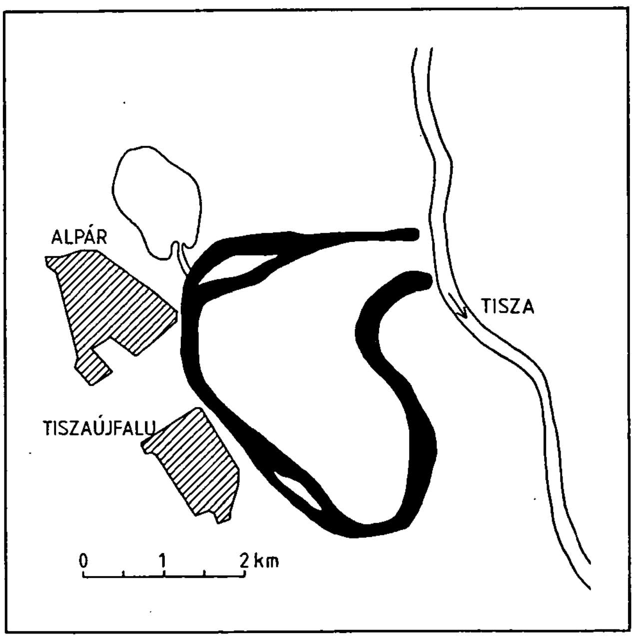

Fig. 1. The backwater at Alpár.

various kinds of mercury compounds firstly accumulate with surface absorption on the algae and other water plants. Fish take up the mercury compounds directly through the alimental chain, at the same time, the transmission of the already bound compounds is very slow (JERNELÖV 1973).

Cadmium occurs in the natural waters with a value of a few mg/e, generally in the company of other toxic material. Cadmium inhibits the kidney and liver functions in the case of the living beings of higher order and also causes the demineralization of the osseous system (KOWAL 1979).

Chromium is necessary in minimal amount for the living organisms. The biological activity is stricted to the trivalent form of chromium, at the same time, the hexavalent chromiumcompounds are of strongly toxic effect. The tri- and hexavalent forms are harmful to fish in nearly similar concentrations (PICKERING 1966).

In the past year the Water Quality Protection Department of the Water Conservancy Directorate at the Lower Tisza Region has turned particular attention to studies on the backwaters along the Tisza river. Contributing to the research activities of the Tisza Research Committee, the Department has monthly studied the chemical parameters — among them also the occurrence of heavy metals — of the backwaters at Alpár and Lakitelek.

The Alpár backwater (Fig. 1) is situated East from the village Tiszaalpár in the length of about 11,3 km. Its average width is 130 m. It is protected from the overflow

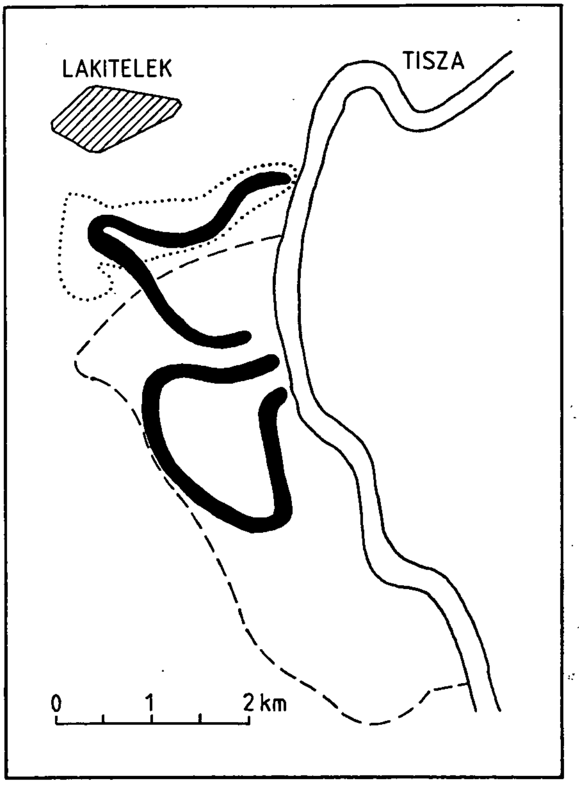

Fig. 2. The backwater at Lakitelek.

of the Tisza by a Summer dam, which provided protection earlier in the case of low and medium water levels. In the meantime, the dam has been heightened, thus no Tisza water enters the backwater even in the case of the moderately high water level of the Tisza river. The filling up of the dead channel is partly accomplished from the Tisza water, when it is at high level, and partly from inland water, as apart from its direct watertank, it can also be filled from the channel at Alpár—Nyárlőrinc. The dead channel is utilized for extensive fishing and extraction for watering.

The backwater at Lakitelek (Fig. 2) is located East from Lakitelek. Its length is 10,5 km, and average width 100 m. Here also a Summer dam protects it from the small and medium floods of the Tisza river. The refilling of the backwater is also possible from the moderate inundations through a lock, apart from the great waters of the Tisza. The water is used for extensive fishing and watering.

Materials and Methods

During the course of our studies, we wished to examine the seasonal changes of the backwaters water quality, with special regard to the heavy metals. For this purpose, water samples were taken ance monthly from the free water surfaces representing the water of the backwaters.

To determine the chemical oxygen demand, the samples were conserved with vitriol in an omount of 5 mg/l. The samples serving for the determination of the ammonium- and nitrate content were stored in cold and these components were determined within 24 hours from the time of sampling. For the determination of the heavy metals the samples were collected in polyethylene flasks, to which 5 ml of concentrated nitric acid and a few crystals of EDTA were added for the purpose of conservation. These samples were processed within 5 days in the laboratory (Batley 1977). The ammonium-ion- and nitrateconcentrations of the water samples were determined with spectrophotometry.

The organic matter-loading of the waters was characterized by the values of the chemical oxygen demand. The latter was determined in acidic medium with potassium-dichromate.

The sodium- and potassium-concentrations essential from the viewpoint of water life were measured by flame photometry in the backwaters.

The pH values of the water samples were determined with electrochemical methods using a Radelkis pH-measuring apparatus.

The above studies were carried out according to the methods recommended in the publication "COMECON Uniform Water-Studying Methods; Second Edition, Budapest, 1975".

In the surface waters of Hungary the concentration of the heavy metals does not reach the lowest concentrations definable by the applied atom absorption technique. Therefore, the samples were previously concentrated, during which course attempt was made to extract the possible disturbing components from the water — first of all the organic matter. The degree of concentration was selected so that the lowest concentrations could also be measured in the water, which have been observed by Hungarian authors in our surface waters (Literáthy 1977, Bozsai 1978). 5 ml of vitriol and 25 ml of concentrated nitric acid were added to the 500 ml part of the conserved and homogenized water samples, then evaporated down on water bath till the appearance of sulphuric acid fume. If the residue evaporated dry was not colourless, further 5 ml of concentrated nitric acid was added to it and the drying by evaporation was repeated. The dried samples were raised with 1 ml of 10% hydrochloric acid, and then their volume was amplified to exactly 25 ml in volumetric flask. In such way, 20-fold enrichment was gained from the original water samples.

The concentrations of the heavy metals were determined with the help of Spektromom 190 A-type atomic absorption spectrophotometer. The uptake of the calibration curves regarding the various metals was accomplished in such way that considering the enrichment, the tenth of the end values recommended for surface waters could still be demonstrated with the help of flame-atomization technique (Literáthy 1977).

Acetylene-air flame was used in the case of cadmium, zinc, chromium, manganese, copper and iron; and the so-called cold vaporous atomization was applied for the determination of mercury (*Hungarian Optical Works* 1978).

The analytical data of the calibration and sample measurings were determined on the basis of the literature regarding the applied atom absorption technique (Price 1977).

Results and discussion

1. Figure 3. shows the organic matter loading of the water at the Alpár backwater. It could be determined that the organic matter content of the water was practically the same, with the exception of a high value at early summer and autumn. The ammonia — which is mostly the representative of fresh contamination in the case of surface waters — appeared in relatively constant concentration in the backwater in the Spring and Summer months, and its amount increased in the winter months. The tendency was similar in the case of nitrate. Apart from this, higher nitrateconcentrations were measured also in the months of March and April. It can be concluded from these that the effect of the excessive nutrient solutions washed in from the agricultural areas in the environs of the backwater appeared in the Winter and Spring months (Fig. 4).

Figure 5. demonstrates the changes in the sodium- and potassium-contents of the water. Here, too, the aforementioned tendency prevailed, in so far as the amount of potassium increased in the Winter months. In the case of sodium, there was a Summer (June, July) and an Autumn-Winter maximum, respectively.

The concentrations of the various heavy metals measured in the bottom sediment and the water were in equillibrium with each other (LITERÁTHY 1982).

Figure 6. demonstrates the development of the essential heavy metal concentrations — copper, zinc, iron, and manganese — in the Alpár backwater.

The Content copper showed interesting seasonal change. Increased values were observed in April, and expressedly high values were demonstrable in July—August. It has been mentioned in the fore-goings that the *Spirogyra* algal species are sensitive against copper. In the backwater, *Spirogyra* algae were detected in the spring months, however, the species disappeared from the water at the time of the extremely high copper-concentration in July—August. Studying the development of the zinc-content, it can be determined that the maximal concentrations were measured between the

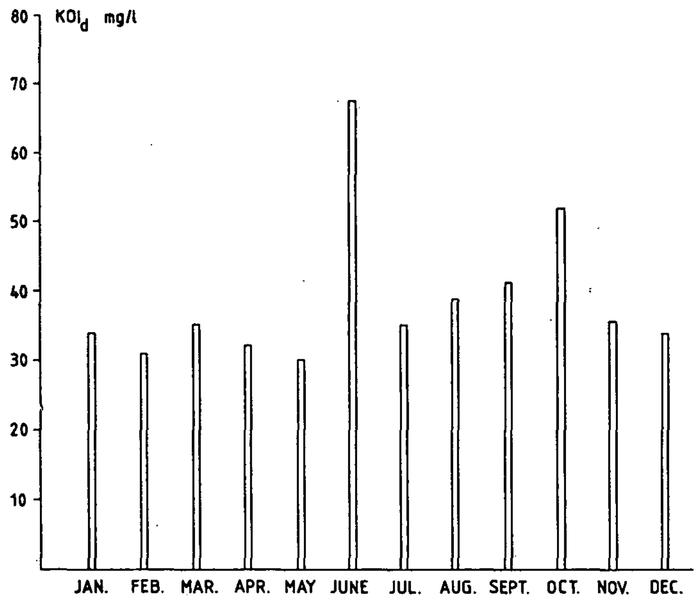

Fig. 3. Organic matter loading of the Alpár backwater on the basis of CODd.

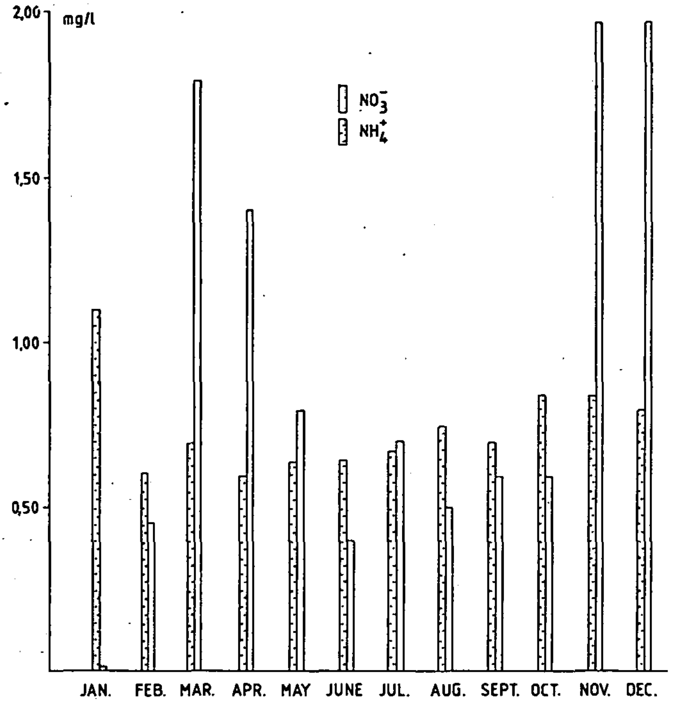

Fig. 4. Changes of ammonia- and nitrate-concentrations in the Alpár backwater.

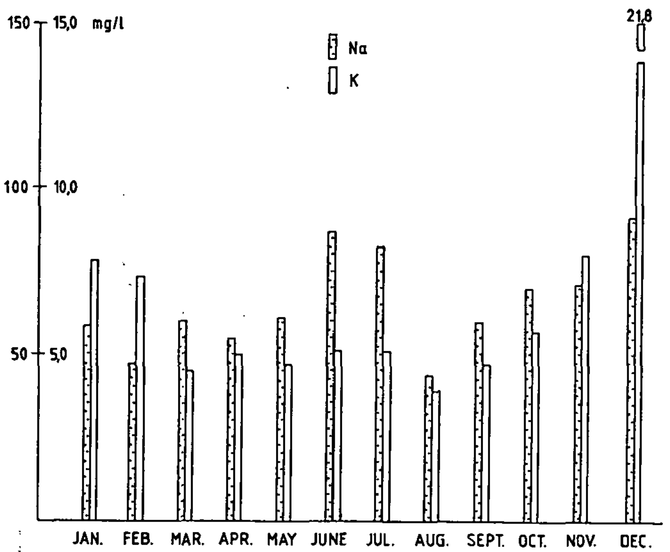

Fig. 5. Seasonal changes of the sodium- and potassium-contents in the Alpár backwater.

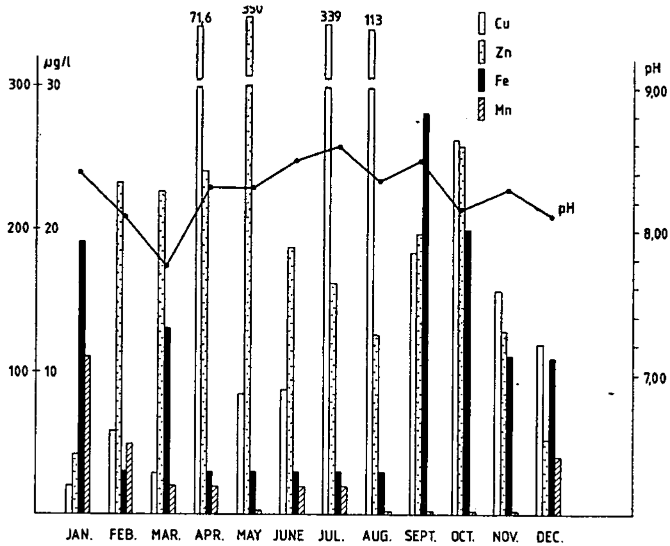

Fig. 6. Changes in the concentrations of the essential heavy metals in the Alpár backwater.

pH 8,2—8,3 values of the water. Both the lower and higher pH values led to the decrease in zinc-content. The prominent zinc-concentration measured in May allows to draw an interesting conclusion. On the basis of the pH value of the water, this should be between the values of 200—250 mg/l. At the same time, it was found that close to 25% of the algae present in the water (2,5 million from 11 million individuals per liter) was the *Chlorella* species, a type of alga markedly fond of zinc; incorporating large quantities of zinc in its organism. According to our opinion the increase in zinc-concentration and the increase in the amount of the *Chlorella* can be brought into correlation.

Higher iron-concentrations were observable in the autumn and winter months, than in the other periods of the year. In January and October practically identical iron-contents were registered (values of 190 and 200 mg/l, respectively), at the same time the saprobity indexes calculated for the water biology qualification were 1,81 and 1,84, resp. Similar relationship could be demonstrated between the months of March and December. It could be concluded from these data that the organisms fond of iron increased in the mentioned periods.

In the Alpár backwater the concentration of manganese decreased to zero value in the spring and autumn months. Maximal values were measured in winter. No relationship similar to those mentioned above was experienced. The concentrations of the expressedly toxic heavy metals — mercury, cadmium, chromium — are shown on Figure 7.

A minimal amount of mercury-content was observed in the first months of the year. In the months of March, April, May and June, however, the mercury-concentration increased by orders. This could be explained by the fact that the Spring inland waters from the surrounding agricultural fields presumably exported a significant amount of mercury to the backwater, which remained in dissolved condition throughout a longer period. Since this relatively high concentration was detectable for a rather short period, its chronic effect on the water organisme could not be demonstrated.

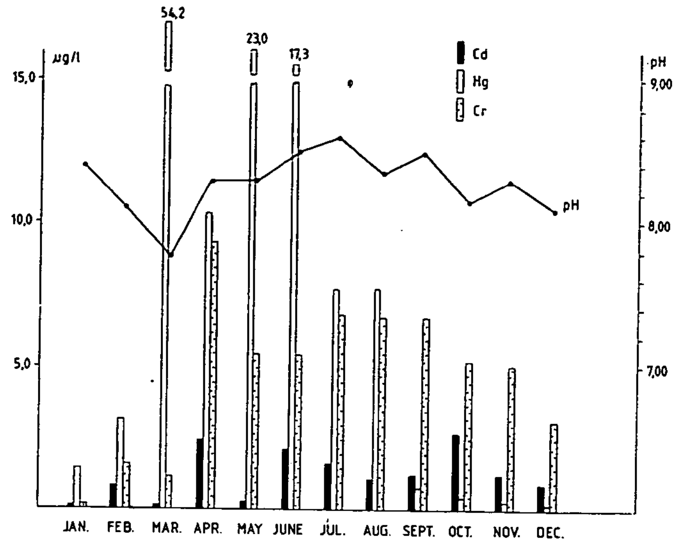

Fig. 7. Changes in the concentrations of three toxic heavy metals — mercury, cadmium, chromium — in the Alpár backwater.

The cadmium-content of the water did not refer to any kind of contamination. The water practically contained this heavy metal in an amount equivalent to the natural cadmiumcontent of surface waters.

The development of the chromium-concentration can also be seen on this figure. It is observable that presumably as the consequence of the sudden change in

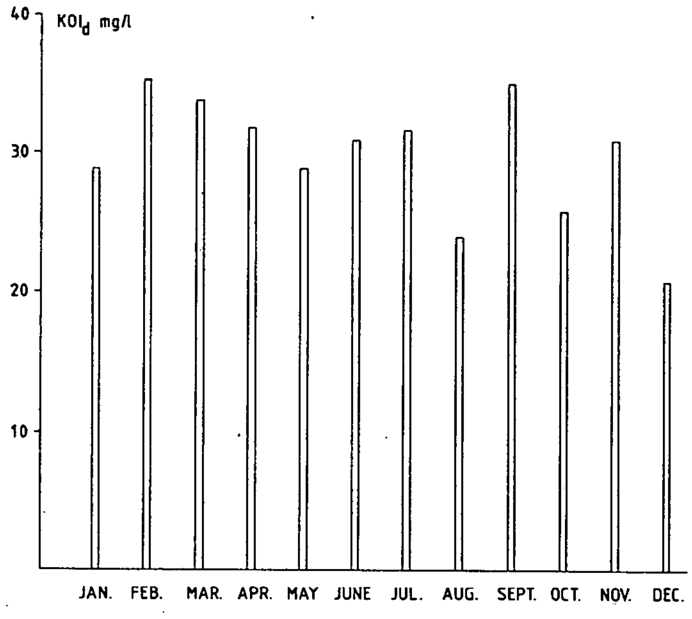

Fig. 8. Organic matter loading of the Lakitelek backwater on the basis of CODd.

pH, the chromium compounds accumulated in the bottom-sediment became mobilized, since their amount increased in the backwater. A balanced condition set in virtually with the settling of the pH-value. The chromium-concentration decreased with that of the pH in the autumn months. Due to the fact that there was an increase in the solubility of the trivalent chromium compounds with the decrease of the pH (PAYNE 1975), it may well be assumed on the basis of the fore-goings that the majority of the total chromium measured by us was present in the form of hexavalent chromium. Studies are in progress regarding the differentiation of these compounds.

2. Samplings were achieved also monthly from the backwater at Lakitelek, and analyses were performed similarly to those described above. Figure 8 illustrates the organic matter-loading of the backwater on the basis of the chemical oxygen demand calculated with potassium dichromate. The values of this varied between 21—36 mg/l, practically meaning a constant value.

Figure 9. demonstrates the annual change in the ammonia- and nitrate-contents at the backwater. The concentration of ammonia was relatively constant in the backwater, increased values were only measured in January and April. Studying the nitrate-concentration it can be seen that it increased in the autumn — winter months. To a certain degree, this is also in correlation with the effect of the inland waters.

Figure 10. shows the changes in the water's sodium- and potassium-content. The concentration of sodium slightly rose by the autumn months, that of potassium practically remained constant.

On the basis of the above water quality indexes it can be determined that the water quality of the backwater at Lakitelek is more stable than that of the above reviewed Alpár backwater.

The concentrations of the essential heavy metals at the Lakitelek backwater are demonstrated on Figure 11. The concentration of copper in the backwater slightly

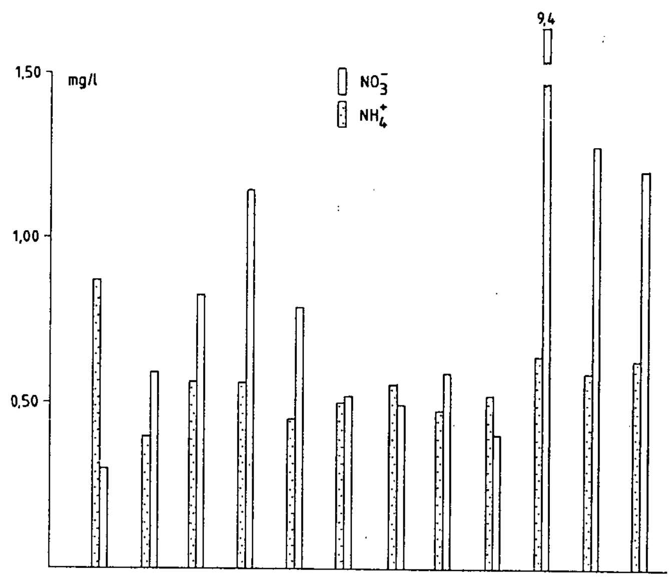

Fig. 9. Changes in the ammonia- and nitrate-concentrations in the Lakitelek backwater.

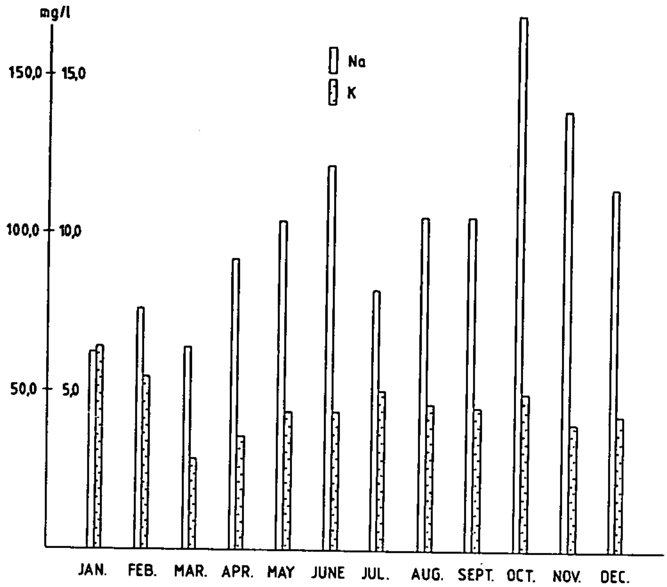

Fig. 10. Seasonal changes of the sodium- and potassium-contents in the Lakitelek backwater.

increased in the Spring and Autumn months. Nevertheless, this increase is not of such degree that it would lead to the decrease in the amount of the organisms sensitive to copper.

Determinations similar to the fore-goings could be made in the case of the zinc-content. Rather high zinc-concentration was registered from the backwater in the months of June, July and August. In these months, relatively increased amounts of

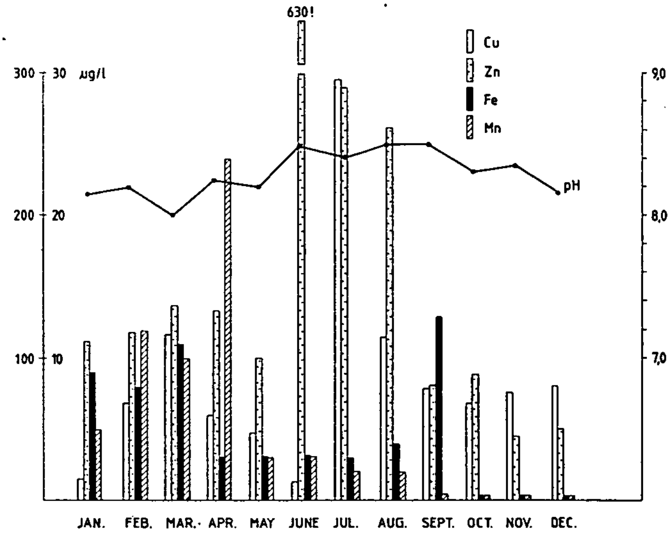

Fig. 11. Changes in the concentrations of the essential heavy metals in the Lakitelek backwater.

the *Chlorella* alga species' individuals were observable in the water during the course of the biological studies. As mentioned earlier, these algae are particularly fond of zinc. There was also a relationship between the increased zinc-concentration and the increase in *Chlorella* in the case of this backwater.

The amount of iron increased in the Spring and Autumn months, and was unchanged in Summer. In the months of January—February, when the iron-concentration at the backwater was virtually the same, the saprobity indexes also showed values of 1,97 and 1,93, respectively. The same could be observed in the period between April and August, when the amount of iron was constant and the S-index values ranged between 2,02—2,10.

The manganese-concentration in the backwater was high in the months at the end of Winter—Summer, then it gradually decreased and could not be demonstrated from the water in the Autumn months.

Figure 12. shows the concentrations of the toxic heavy metals observed in the backwater.

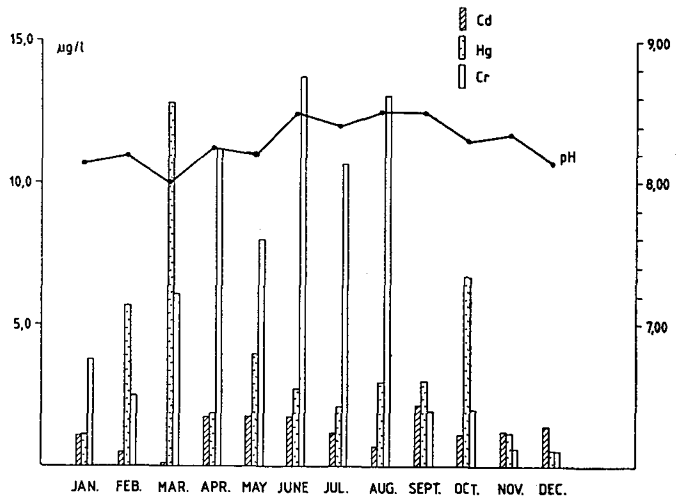

Fig. 12. Changes in the concentrations of three toxic heavy metals — mercury, cadmium, chromium — in the Lakitelek backwater.

In February and March increased mercury-content was registered in the water, which gradually decreased to a minimal value (to a value which could be registered as a natural background in the water of the Tisza river). Higher mercury content was measured in the water again in October, decreasing in the following month. Therefore, the effect of the Spring and Autumn inland waters coming from the agricultural fields was also demonstrable in the backwater et Lakitelek. The effect of mercury was not long-lasting in this case either, thus no chronic alterations could be observed concerning the water organisms.

Cadmium occurred in the backwater in a concentration corresponding to the natural background.

Among the toxic metals, the concentration of chromium was particularly high in the Spring-Summer months at the backwater. Nevertheless, it did not surpass the recommended limit-value (MSZ 12 750).

Regarding the development of the chromium-concentration, the same tendency could be observed as in the case of the Alpár backwater; with the decrease of pH, there was also a decrease in the amount of chromium in the Autumn months. On the basis of this it is assumable that the majority of chromium is present in hexavalent form in this backwater, too.

Considering the experiences gained last year, the followings can be determined:

1. Studies on the essential metals should be continued in the Alpár and Lakitelek backwaters, with particular regard to the zinc- and copper-contents, which showed relationship with the life of the waters. The studies are also wished to be expanded to the bottom sediments so that further basic knowledge could be gained on the conditions of the equillibrium. It is also expedient to perform biochemical studies related to the heavy metals, for which purpose cooperation is necessary on behalf of several teams taking part in the research.
2. Due to the intensive agricultural production going on in our environment, the water and living world in the backwaters are still loaded with mercury, from the toxic heavy metals. It is unambiguously striking from the studies on cadmium that this metal does not occur in significant concentration in the backwaters, therefore its further studying is not thought to be expedient. It is of importance to decide what proportion of the total chromium-content measured by us is given by the hexavalent chromium compounds. The samples originating from the bottom sediments should be included in the studies on the toxic heavy metals, to obtain a complete as possible image of the equillibrium and transport processes taking place in the backwaters.

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A vízi biocönózisokra hatást gyakorló nehézfémek vizsgálata az Alpári és Lakitelki holtágak vizében

E. FEKETE

Alsótiszavidéki Vízügyi Igazgatóság, Szeged

Kivonat

1982. évben az Alpári és Lakitelki holtágak vizében havi gyakorisággal meghatároztuk azokat a nehézfémeket, amelyek hatást gyakorolnak a vízi élővilágra. Vizsgálataink a víz réz-, kadmium-, cink-, króm- és higanytartalmának meghatározására irányultak. A nehézfémek vizsgálata mellett meghatároztuk a holtágak vizében a szervesanyag-tartalmat. figyelemmel kísértük az ammónia- és nitrátkoncentráció alakulását. A nehézfémvizsgálatokhoz kapcsolódóan határoztuk meg a víz pH-ját, valamint nátrium- és káliumtartalmát, A vizek cink- és réztartalma, valamint a vízi szervezetek száma között összefüggéseket figyeltünk meg. Megállapítottuk, hogy a két holtág vizének jelentős a higanytartalma, amely külső szennyezésre utal.

Анализ тяжёлых металлов, влияющих на водные биоценозы, в воде мёртвых русел Алпар и Лакителек

Е. Фекете

Водное Управление областей нижнего течения Тисы, Сегед

Резюме

В 1982 годы мы ежемесячно проводили определение тяжёлых металлов, влияющих на водный живой мир, в воде мёртвых русел Алпар и Лакителек. Наши анализы были направлены на определение содержания в воде меди, кадмия, цинка, хрома и ртути. Наряду с определением тяжёлых металлов, в воде мёртвых русел мы определяли также содержание органического вещества, а также наблюдали формирование концентрации аммиака и нитрата. Параллельно с анализом тяжёлых металлов, мы определяли также содержание рн воды и содержание натрия и калия. Нами наблюдалась зависимость между содержанием цинка и меди, с одной стороны, и количеством водных организмов — с другой.

Установили, что вода обоих мёртвых русел содержит значительное количество ртути, что свидетельствует о внешнем загрязнении.

Ispitivanje uticaja teških metala na biocenoze mrtvaja Alpár i Lakitelek

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Vodoprivredna uprava, Szeged

Abstrakt

U 1982. godini odredjivani su u mesečnim intervalima u vodama mrtvaja Alpár i Lakitelek oni teški metali koji utiču na živi svet voda. Ispitivanja su bila usmerena na odredjivanje bakra, kadmijuma, cinka, hroma i žive u vodi. Pored ispitivanja teških metala odredjivan je i sadržaj organskih materija. Praćena je koncentracija amonijaka i nitrata u mrtvajama. Takodje je utvrdjivan i pH, te sadržaj natrijuma i kalijuma. Uočena je uslovljenost izmedju sadržaja cinka i broja vodenih organizama. Konstatovana je značajna količina žive, koja upućuje na zagadjenje mrtvaja.

Tiscia (Szeged) Vol. XIX, pp. 17—20 (1984)

SUMMARIZING EVALUATION OF THE RESULTS OF THE DAPHNIA TEST CARRIED OUT AT THE TISZA-SECTION AND MAJOR DISTRICT WATERS AT SZOLNOK COUNTY (1977—1983)

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(Received November 3, 1983)

Abstract

Between 1977—1983 acute toxicological studies were carried out with *Daphnia* at six points of the Tisza-section at Szolnok county and at the major district waters of the region. It was determined that in the studied periods 21 % of the Tisza water samples and 4.8 % of the samples originating from the district waters were of toxic effect on the *Daphnia*. From 1975 to nowadays, the positivity of the Tisza water samples taken with great frequency above the area of the surface Water Works at Szolnok showed strongly decreasing tendency; falling back from 74 % to 1.2 %. The positivity was strikingly higher in the cooler, colder months. As the cause of this phenomenon, it is presumed that the rate of the chemical and micro-biological decomposition of the physiologically affective toxic material shows a decrease in the water of lower temperature.

Introduction

Since 1974, the Water Micro-biological Laboratory of the Service of Public Health and Epidemiology of Szolnok County carries out regular chemical, bacteriological, biological and toxicological studies tending to reveal the environmental effects. Those acute toxicological studies were emphasized several times from the complex hygienic programme, within the frame of which biological tests were accomplished in respect to the Tisza river at the area of Szolnok county, and the major district waters at the region, as well as the drinking water of Szolnok city, provided from the Tisza river. Here, we only wish to refer to a few data published earlier in this topic (CSÉPAI 1975, 1976, SCHIEFNER et *al.* 1979, KÁDÁR 1983).

In the followings a review is given on the results of the *Daphnia* toxicity tests carried out between the period 1977 and October 31, 1983.

Materials and Methods

The water samples were taken from the sites which will subsequently be given, transported in refrigerated state, and processed within 24 hours after moderation to laboratory temperature. The *Daphnia* toxicity tests were performed and the results evaluated according to the specifications for the Hungarian *Daphnia* test (Water Toxicological Studies, 1982). The principle of the study is that only that sample can be qualified as being negative in which half of the *Daphnia* do not become destroyed within the 48 hours' period of exposition; in opposite case, the result of the *Daphnia* test is regarded as positive.

Results and Evaluation

Within the studied period, 21% of the total samples taken from the length of the Tisza river at Szolnok county proved to be *Daphnia* positive. Figure 1 comprises the positive results from the 8 sampling sites of the Tisza river. It could be determined from the Figure that the Tisza river is firstly toxic on *Daphnia* in the Autumn, Winter and early Spring months. These facts refer to the role of temperature elements in the displaying of the effects of the toxic micro-contaminants occurring in the Tisza water.

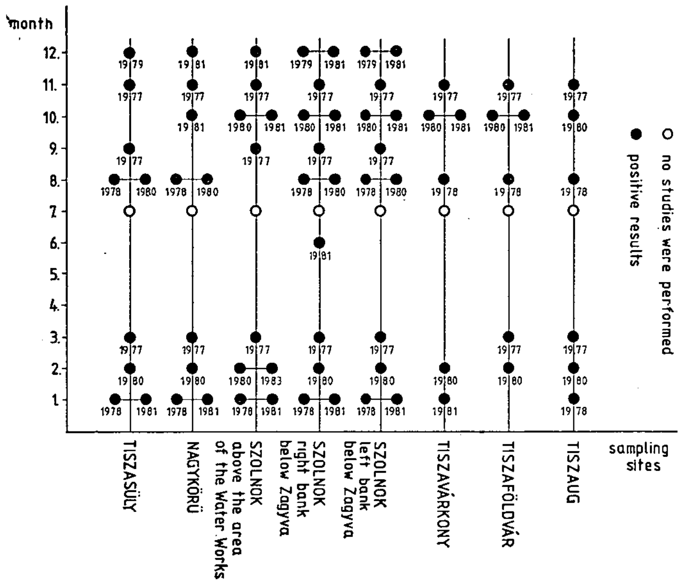

Fig. 1. Seasonal frequency of the positive results of the *Daphnia* test carried out an 6 occasions annually at the Szolnok county section of the Tisza river, between 1977—1983 (October 31).

The toxicity of the district waters is of slight degree; the positive samples amount ot 4.8% of the total studied samples. Figure 2 shows the positive results of the *Daphnia* test carried out on 6 occasions at 11 sampling sites of the more important district waters of Szolnok county, also in seasonal distribution. From the viewpoint of seasonal positivity, the relationship is similar to that experienced during the course of the studies at the Tisza river. As an explanation to this phenomenon, it can be assumed that the decomposition of the micro-contaminants is a slower process in the water of lower temperature. Under such circumstances there is a general decrease in the rate of the chemical reactions, which is also the case regarding the decomposing activity of the micro-organisms.

The results were also favourable regarding the acute water toxicological studies involved in the complex survey carried out between 1974 and 1978 at the Hungarian longitudinal segment of the Tisza river — with the exception of the high positive peak from the year 1975 (74%), (SCHIEFNER et al. 1979). Figure 3 demonstrates, with the purpose of continuity, from 1974 to October 31, 1983, the development of the *Daphnia*-positive results of the Tisza water samples taken from the area before the

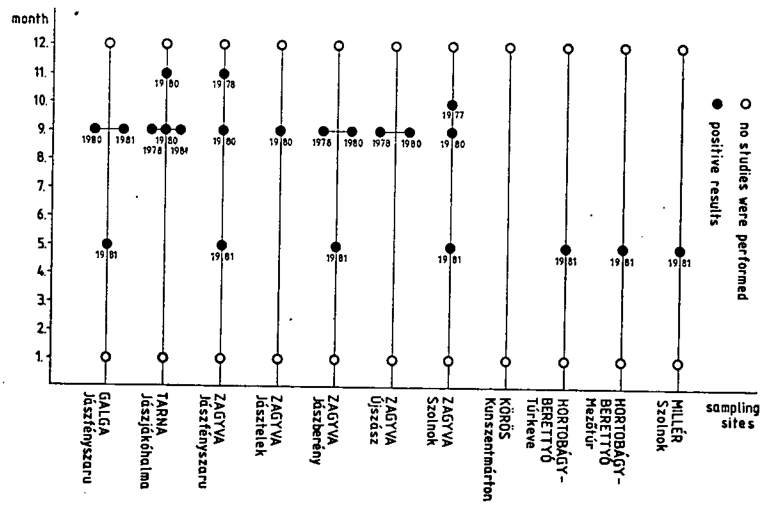

Fig. 2. Seasonal frequency of the positive results of the *Daphnia* test carried out annually on 6 occasions at the more important district waters of Szolnok county between 1977—1983 (October 31).

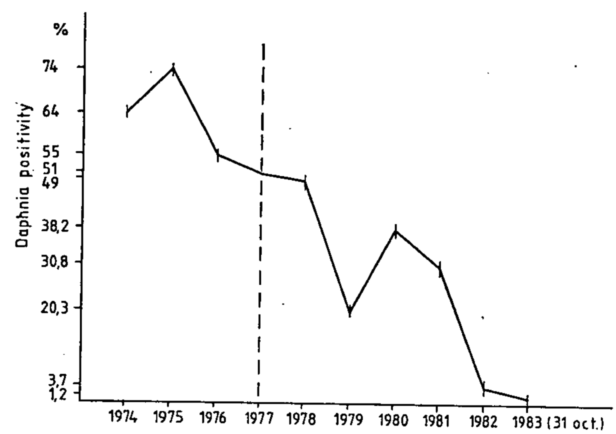

Fig. 3. The *Daphnia*-positive results obtained from the Tisza river above the area of the Water Works at Szolnok between 1977—1983 (October 31), on the basis of 100 studies yearly.

Szolnok surface Water Works. Till the end of the studied period, the strongly decreasing tendency of the positivity can be determined from the Figure; only 1.2% of the samples studied as yet in 1983 proved to be positive.

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A Szolnok megyei Tisza-szakasz és a fontosabb mellékvizek Daphnia teszt eredményeinek összefoglaló értékelése (1977—1983)

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Kivonat

1977—1983 között akut toxikológiai vizsgálatokat végeztünk Daphniákkal a Tisza Szolnok megyei szakaszának 6 pontján és a megye fontosabb mellékvizein. Megállapítottuk, hogy a vizsgált időszakban a Tisza vízminták 21%-a, a mellékvizekből származó minták 4,8%-a volt Daphniákra mérgező hatású. A szolnoki felszini vízmű felett nagy gyakorisággal vett Tisza vízminták pozitivitása 1975 után napjainkig erősen csökkenő tendenciát mutat; 74%-ról 1,2%-ra esett vissza. A pozitivitás szembetűnően nagyobb arányú volt a hűvösebb, hidegebb hónapokban. E jelenség okaként feltételezhető, hogy a fiziológiailag hatásos toxikus anyagok kémiai és mikrobiológiai lebontásának sebessége csökken az alacsonyabb hőmérsékletű vízben.

Общая оценка результатов тестов с Daphia в воде протекающей на территории обл. Солнок р. Тисы и её основных притоков (1977—83)

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Резюме

В 1977—1983 гг. нами были проделаны токсилогические исследования с Daphnia в шести местах протекающей по территории области Солнок р. Тисы и в воде её основных притоков. Мы установили, что за исследуемый период 21% водных проб Тисы и 4,8% проб её притоков оказались токсичными для Daphnia.

Пробы, которые часто брались выше водонапорной станции в Сольноке, свидетельствуют о сильно снижающейся тенденции позитивности воды Тисы с 1975 года до наших дней (она упала с 74% до 1,2%). В более прохладные, холодные месяцы эта положительность воды заметно возрастала. Можно предполагать, что причина этого явления заключается в том, что скорость химического и микробиологического разложения оказывающих физиологическое влияние токсических веществ в более холодной воде снижается.

Vrednovanje rezultata istraživanja reke Tise i značajnijih sporednih voda županije Szolnok, dobijenih Daphnia testom (1977—1983)

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Abstrakt

U periodu 1977—1983. godine, sa šest punktova reke Tise i sa značajnijih sporednih voda županije Szolnok, vršena su akutna toksikološka ispitivanja pomoću dafnija. Utvrdjeno je da su u navedenom periodu uzorkovane vode reke Tise u 21%, a uzorci iz sporednih voda u 4,8% bile otrovnog dejstva na dafnije. Kvalitet vode, uzete sa velikom čestoćom iz akumulacija reke Tise iznad Szolnok-a, od 1975. godine do današnjih dana, pokazuje tendenciju jakog opadanja: sa 75% na 1,2%. Pozitivitet je očigledno bio većih razmera u hladnijim mesecima. Kao uzrok ove pojave pretpostavlja se, da brzina razlaganja fiziološki efikasnih hemijskih i mikrobioloških toksičnih materija, opada pri nižim temperaturama.

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BIOLOGICAL WATER QUALITY OF THE TISZA BETWEEN TOKAJ AND TISZAFÜRED

(ON THE BASIS OF STUDIES CARRIED OUT BETWEEN THE PERIOD 1971—1980)

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(Received May 25, 1983)

Abstract

A comparison is given of the results of the water quality studies carried out between 1971—1980 in the two characteristic segments of the Tisza (Tiszatardos and Tiszakeszi). The evaluated 10 years' period can be divided into 5-yearperiods, characteristic of basically differing water qualities: with values mostly under 500 m^3/s between 1971—1975; and values above 500 m^3/s between 1976—1980 — on many occasions essentially surpassing even 1.000 m^3/s.

The comparative evaluation of the two 5-year-periods unambiguously refers to the fact that the water quality of the Tisza is fundamentally determined by the water output, with the increase of which at the same time there is also a higher amount of biologically accessible nutriments. However, it should not be left unconsidered that between the period 1971—1980 there was a substantial increase in the utilization of chemical fertilizers having N and P effective agents, which show decisive influence on the development of the nutriment concentrations and their loading, respectively.

On the basis of the evaluated water quality characteristics, it can be determined that significant decomposition took place in both segments, bieng more expressed in the Tiszakeszi segment than in that of Tiszatardos. The cause of this may first of all be in the washing ins originating from areas belonging to the channel section between the two segments.

The biological water quality of the Tisza: beta-alphaoligohalobic, beta-limnotyped; oligo-mesotrophic (in Winter: atrophic, in the growing season: eupolytrophic); between betamesosaprobic-alpha-mesosaprobic; not of toxic type.

The algae population maximums are firstly characterized by the domination of diatoms (Bacillariophyceae). The changes in the chlorophyll a content at the time of subsiding of the algae population maximums are unambiguously in correlation with the changes of the total algal count within the longitudinal segment.

From the plant-nutriments, the dissolved reactive phosphorus should be regarded as a limiting factor, compared to the participation ratio of which the ratio of nitrogen is over 7-folds and that of carbon is close to 20-folds.

On the basis of the comparative evaluation of the two segments it can be determined that the water quality of the Tisza is acceptable in general, nevertheless, the results characteristic to the unfavourable conditions cannot be neglected either.

Introduction

To characterize the water quality of the Tisza channel section (practically between Tokaj and Tiszafüred) belonging to the field of activity of the Northern Hungarian Water Conservancy Directorate, the results of a 10 years' study were evaluated at two segments:

Tiszatardos, where its water quality is determined by the pollutions brought from the upper course and by the water quality of the Bodrog;

Tiszakeszi, where its water quality — beyond the foregoings — is influenced by the water quality of the Sajó and by the sewages from the area of Leninváros.

The two selected segments are thought to be suitable to characterize the water quality of the Tisza arriving to and flowing out of our district. Naturally, during the course of the evaluation the results of other studied segments belonging to our range of activity were also taken into account (see supplemented map), (as well as casually the features of periods before 1971 and after 1980) — which, according to sense, are referred to in given cases.

The review on the special literature dealing with the water quality of the Tisza (in certain cases being greatly detailed, in other cases being unfortunately scanty) was purposely avoided, since this present study wishes to evaluate exclusively the results of the water quality examinations of the ÉVIZIG. (Northem Hungarian Water Conservaney Directorate).

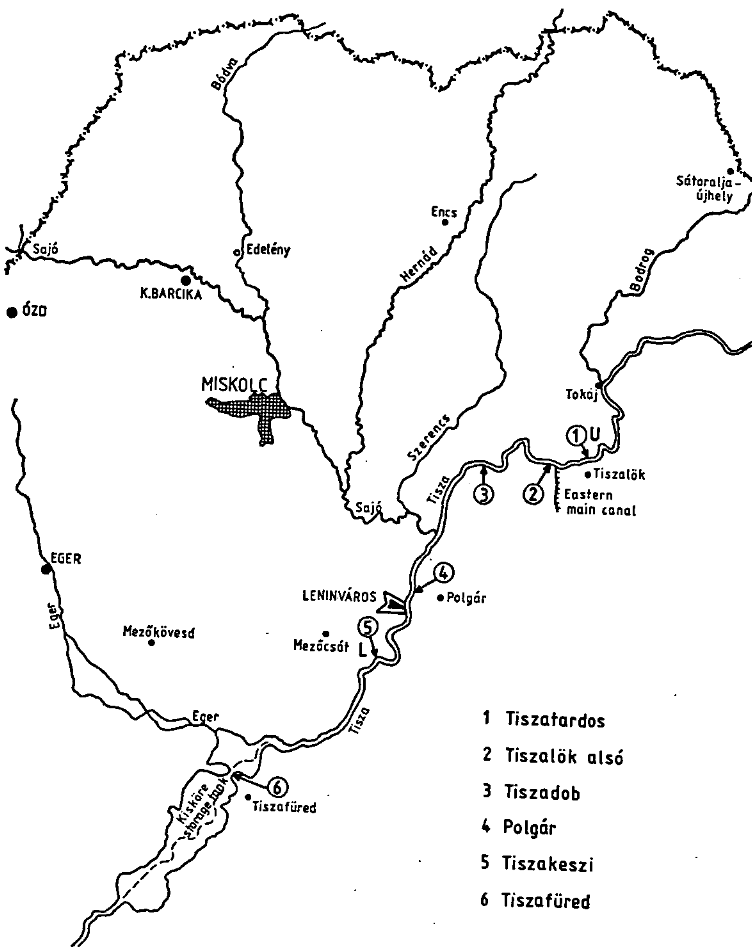

Fig. 1.

Materials and Methods

The Laboratory for Water Quality Examinations of the Northern Hungarian Water Conservancy Directorate carries out regular studies on the control of the Tisza's water quality. Being the "basic network sampling areas" determined by the National Water Conservancy Board, the studied segments (see supplemented map) are tightly connected to the study areas of similar object of the Water Conservancy Directorates along the river Tisza.

Our studies were carried out regularly every month on one occasion, thus the 10 years' period could be characterized by the comparative evaluation of 120 study results per segment.

The water samples were as far as possible taken from current line, 20 cm below the water surface, taking into consideration the general rules of water sampling, and also the probable local or periodical changes of the conditions.

The studies were performed with the aid of the COMECON project (1975) as well as the methodological collections by FELFÖLDY (1974) and SZILÁGYI (1982). The methodological instructions regarding algological studies and the books of determinations used have already been reported in an earlier publication of the author (1981), therefore these shall not be listed here.

In the original essay, the changes of the more important water quality characteristics were also evaluated by author according to the statistical method of the "totalized or remaining behind frequency". Since this would not fit into the frame of the present paper, the original manuscript

Reviewing and evaluation of the study results

In the first part of this paper the changes in time and space of the more important water quality features are compared in the case of the two segments. During the course of the evaluation, author found it noteworthy that compared to the first (1) 5-year-period (1971—1975) the water quantities belonging to the various studies were essentially greater in the second (2) 5-year-period (1976—1980). This also necessitated the calculation of the "loading" of the more important water quality characteristics. (Regarding that due to the banking up at Kisköre, no series of data are available concerning water quantity for the last past years at the Tiszakeszi segment, this activity could only be accomplished in the segment of Tiszatardos).

In the further part of this paper — in compliance with the selected topic — the more important water quality characteristics are evaluated according to the property-groups of biological water quality. (The biological water quality of the Tisza — abstaining from taking up a position in the question of principle — was evaluated on the basis of the project utilized in the water conservancy practice.) In this subject, the quantity and ratio compared to each other of the nutriments (carbon — nitrogen — phosphorus) essential for the plants are discussed separately. Here the evaluation is given of the changes in the dissolved oxygen content, which is inseparable from the biological happenings going on in the water.

The changes in time of the water quality in the two 5-year-periods refer to the fact that compared to the years 1971—1975, in the case of NO_3^-, COD_p and COD_k, there was a significant decomposition in 1976—1978 in both segments. The average concentrations of NH_4^+, BOD_5 and TDM were practically unchanged. Defined in numerals, the more important changes are the followings:

	Tiszatardos (g/m³)			Tiszakeszi (g/m³)		
	1	2	Deviation	1	2	Deviation
NO_3^-	4,76	5,92	+1,16	5,74	7,46	+1,72
COD_p	3,95	5,86	+1,91	6,03	6,52	+0,49
COD_k	13,0	18,2	+5,2	19,5	21,5	+2,0

The changes in space of the water quality in the two selected segments refer to the fact that compared to the Tiszatardos segment, in the case of NO_3^-, COD_p and

COD_k, significant decomposition took place in both 5-year-periods at the Tiszakeszi segment. The NH_4^+, BOD_5 and TDM changes were of slighter degree.

The more important changes expressed in numerals are the followings:

	1971—1975 (g/m³)			1976—1980 (g/m³)		
	U	L	Deviation	U	L	Deviation
NO_3^-	4,76	5,74	+0,98	5,92	7,46	+1,54
COD_p	3,95	6,03	+2,08	5,86	6,52	+0,66
COD_k	13,0	19,5	+6,5	18,2	21,5	+3,3

(The given numerical values are the average concentrations of five years).

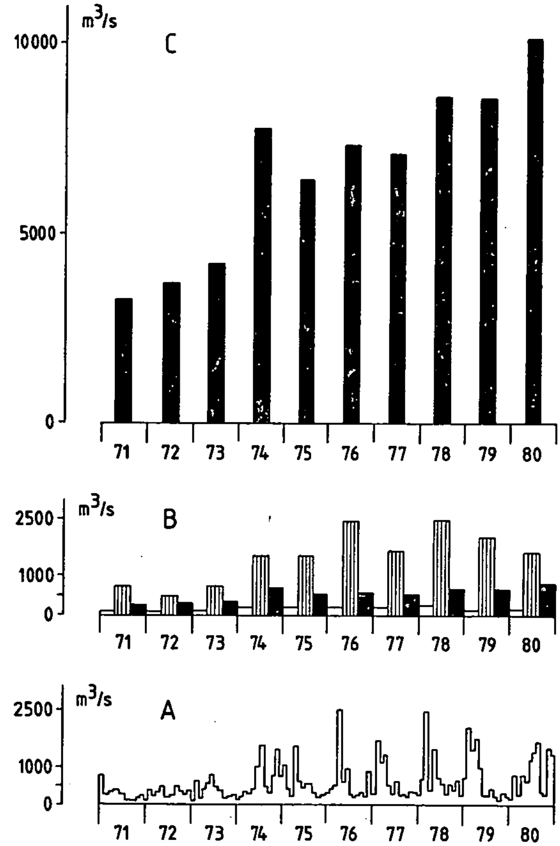

Fig. 2. Characteristic water quantities of the TISZAi n the years 1971—1980.

Beyond the comparison of the two 5-year-periods, the yearly development of the more important water quality characteristics in the two selected segments deserves attention: Table 1 shows the annual minimum-maximum and average values besides each other.

The basically differing water outputs of the two 5-year-periods in the segment of Tiszatardos are observable in Figure 2. It can well be seen that in the period between 1971—1975 the water quantities could be characterized by values mostly under

500 m³/s (the average value of the 5-year-period =423 m³/s), however, between 1976—1980, a great part of the water quantities had values above 500 m³/s (the average value of the 5-year-period = 699 m³/s), in many occasions with values essentially exceeding 1.000 m³/s. It follows from this, that the increase in concentration of the more important water quality characteristics changed in conformity with the increase in the quantity of contamination material. To prove this, the "momentary" quantity values of the certain contamination material were calculated (="loading") — on the basis of the water quantities and contamination material concentrations belonging to all the 120 study time-points of the 10 years' period. The values gained in such a way were totalized yearly. The results are shown on Table 2.

The annually totalized values were also summed up and averaged in each 5-year-period, then -considering the values of the period between 1971—1975 as 100% — the characteristic changes between 1976—1980 were calculated.

The followings should be emphasized from the Table:

— the totalized value of the water outputs at the time of samplings was the lowest in 1971 (the lowest water output — 103 m³/s — of the 10 years' period was in this year), and was the highest in 1980 (the highest — 2500 m³/s — water output of the 10 years' period was in 1976 and 1978, resp.); the degree of change between the two 5-year-periods was: +65%;

— the g/m³ and g/s values of the various water quality characteristics — with few exceptions — were likewise the lowest in 1971 and the highest in 1980. Comparing the two 5-year-periods — with the exception of NH_4^+ — the minimums were found between 1971—1975 and the maximums between 1976—1980.

To analyse the relationship between the water output — concentration — loading, author drew several diagrams on the basis of the 120 studies of the 10 years'period, and evaluating these the following determinations could be made:

— in the case of those water quality characteristics, where the concentration showed well measurable increase (NO_3^-, COD_p, COD_k), the "loading"-increase indicated the occurring changes even more expressedly; in the case of the water quality characteristics where the concentrations practically did not, or only less expressedly change (NH_4^+ — BOD_5 — TDM), the "loading,,-increase made the unfavourable shift of the water quality evident;

— the relationship between the concentrations of the evaluated water quality characteristics and the water output — with the exception of the COD_p and TDM — was found to be loose, and undistinctive, respectively. Namely, the taken up value pairs were found situated in an unorganized mass in the co-ordinate system (in the case of COD_p the location of one part of the value pairs refers to the fact that with the water output increase, there was an increase also in the COD_p concentration; however, in the case of TDM the total value pairs refer to the decrease in the concentration contrary to the increase in water output);

— it is striking, however, that the connection between the water output and the "loading" showed direct proportional relationship in the case of each evaluated water quality characteristic, namely, the increasing water quantities were accompained by the increase in the amount of contamination material.

The previously described alterations can well be seen on Figures 3, 4 and 5c.

During the course of evaluating the results, several other figures were also prepared for the purpose of studying the evident or expectable relationship of the certain water quality characteristics. On the basis of their evaluation — without the demonstration of the certain figures — the followings are thought to be important to emphasize:

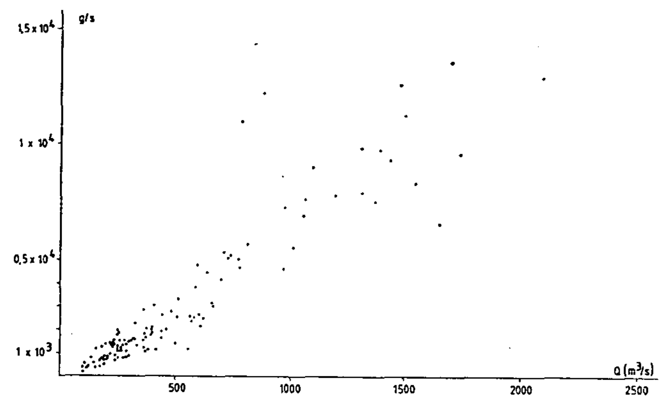

Fig. .3 Relationship between water output and nitrate amount at Tiszatardos between 1971—1980.

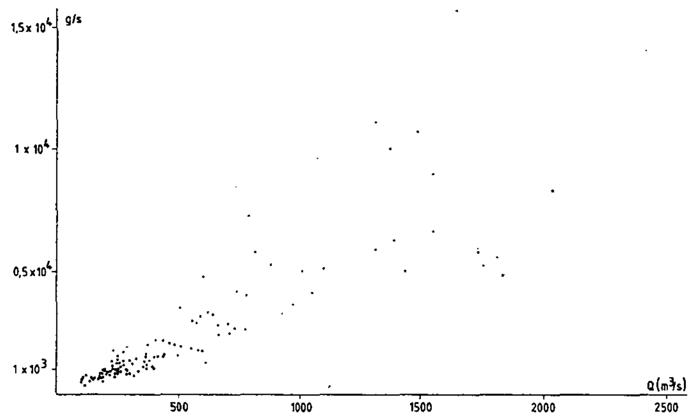

Fig. 4. Relationship between water output and COD_p amount at Tiszatardos between 1971—1980.

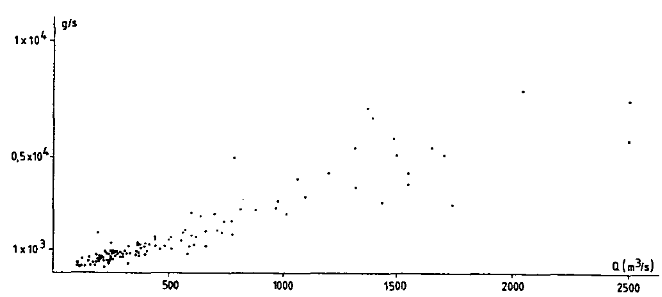

Fig. 5. Relationship between water output and BOD_5 amount at Tiszatardos between 1971—1980.

— the TFM concentration and "loading" are equally in relationship with the water output — with the exception of a few cases — the increase in water output is accompanied by the increase in TFM;
— there is no relationship between the O_2 content and the COD_p, the value pairs are situated in the co-ordinate system in an unorganized mass. This also concerns the relationship of the O_2 and the BOD_5, as well as the O_2 and the NO_3^-;

— the dot mass of the COD_p and BOD_5 value pairs shows a certain degree of proportional ratio;
— the concentration of the TFM and COD_k shows a loose relationship; with a good approach, the "loading" shows a relatedness of proportional ratio, referring to the fact that the COD_k "loading" increased with the growth in TFM.

The biological water quality of the Tisza

"The biological water quality is the complex of those factors, which determine the life of the water eco-system, developing and maintaining them" (FELFÖLDY 1974). Accepting this determination, it is easily conceivable that the biological water qualification of the water area does not exclusively mean the evaluation of the biological studies, but inevitably comprises the evaluation of the total characteristics being in connection with the equatic living world:

Halobity: its total dissolved matter content can in general be characterized by the values belonging to the beta-alpha-oligohalobic province, but the maximums in certain segments belong to the alpha-oligohalobic province. Its composition is characteried by the domination of the Ca^{++} and HCO_3^- ions, furthermore by the $+CO_2$ content; that is beta-limnotyped water-course.

The relationship between TDM and water output is detectable on Figure 6.: it can be seen that the concentration of TDM is of slightly decreasing nature with the increase in water output, and its loading is of increasing nature in a proportional ratio with the water output.

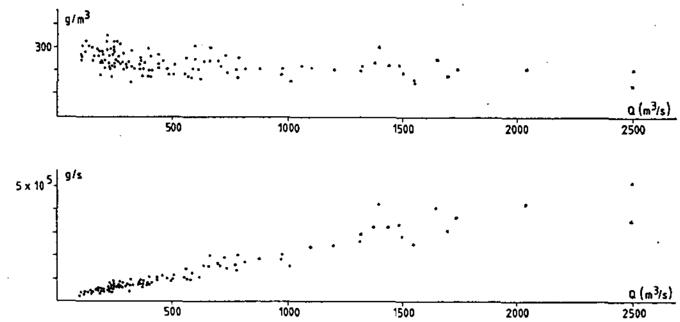

Fig. 6. Relationship between water output and TDM at Tiszatardos between 1971—1980.

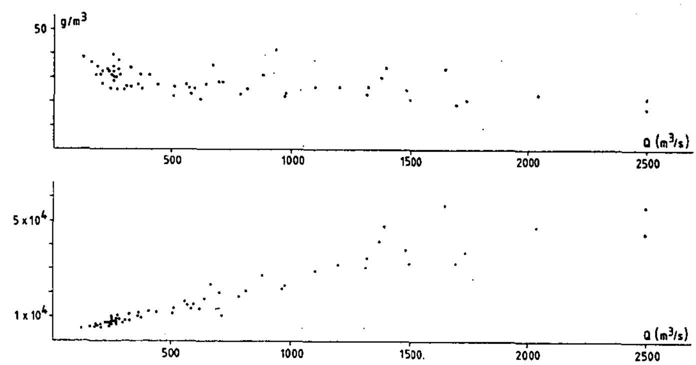

Fig 7. Relativnship between water output and carbon ($=HCO_3^-$ — C) at Tiszatardos between 1976—1980.

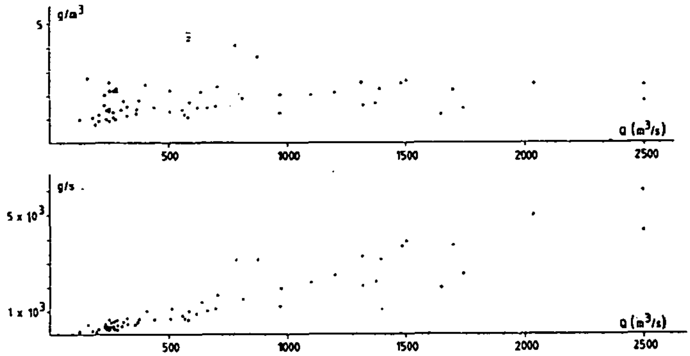

Fig. 8. Retationship between water output and mineral nitrogen at Tiszatardos between 1976—1980.

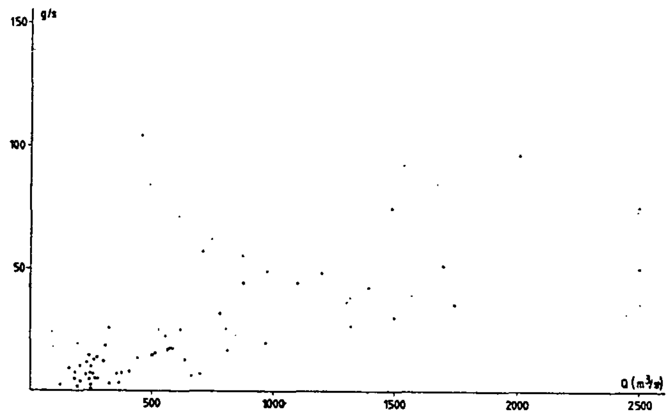

Fig. 9. Relationship between water output and phosphorus ($=PO_4^{3-}$ —P) at Tiszatardos between 1976—1980.

Trophity: in the water of the Tisza there are generally sufficient amounts of nutriments (C—N—P) — accessible by the plants. The relationships between the nutriments and the water output are observable on Figures 7, 8 and 9. The amount of nutriments is dependent on the water output, changing in proportional ratio with is.

These nutriments form the possibility of eutrophization, while the actual degree of this is indicated by the chlorophyll a content. Among the nutriments, the most important is regarded to be the dissolved reactive phosphorus (PO_4^{3-}—P), the amount of which is 0,040 g/m³, counting an average from the results of the total measurings. (End values: minimum=0,003 g/m³, maximum=0,15 g/m³; both at Tiszakeszi). This could result trophity of mesoeutrophic nature. On the basis of the chlorophyll a content, the actual trophity-degree ranges from atrophic nature (zero values were practically even measured in the Winter months) to eupolytrophic nature, but the oligomesotrophic nature is also characteristic. Nevertheless, it is typically of mesotrophic nature in its certain channel sections. The trophity-degree value of the Tisza — in an extreme case: for example in 1975 — was also found to be of eupolytrophic nature.

On the basis of the total algal count, the trophity-degree is generally higher than on the basis of the chlorophyll-a content; this can firstly be explained by the high number of the small-sized diatoms. The study on the longitudinal segments between the period of 07. 06. 1977—08. 06. 1977 is characteristic of the dominating diatoms.

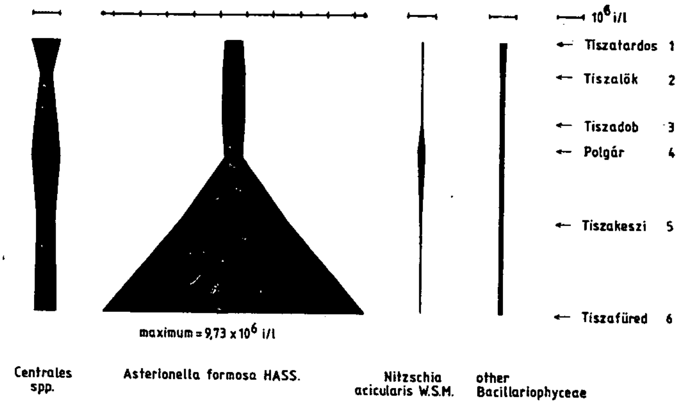

Fig. 10. The Bacillariophyceae composition and distribution of the Tisza in 06.:07-08. 1977.

It can well be seen from Figure 10 that besides the generally characteristic Centrales-taxa the *Asterionella formosa* HASS. Pennales-taxon showed an unexpected increase in the water of the Tisza, pressing out the rest of the algae. It is unfortunate that due to technical reasons, the chlorophyll a content could not be measured at the time of the subsiding of the characteristic populationmaximum.

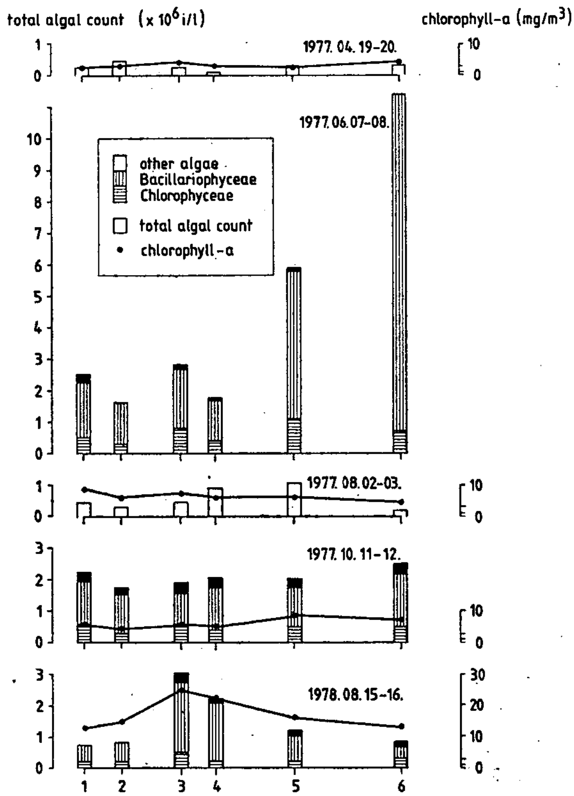

Fig. 11. Results of the characteristic longitudinal segmentstudies at the Tisza (1977—1978).

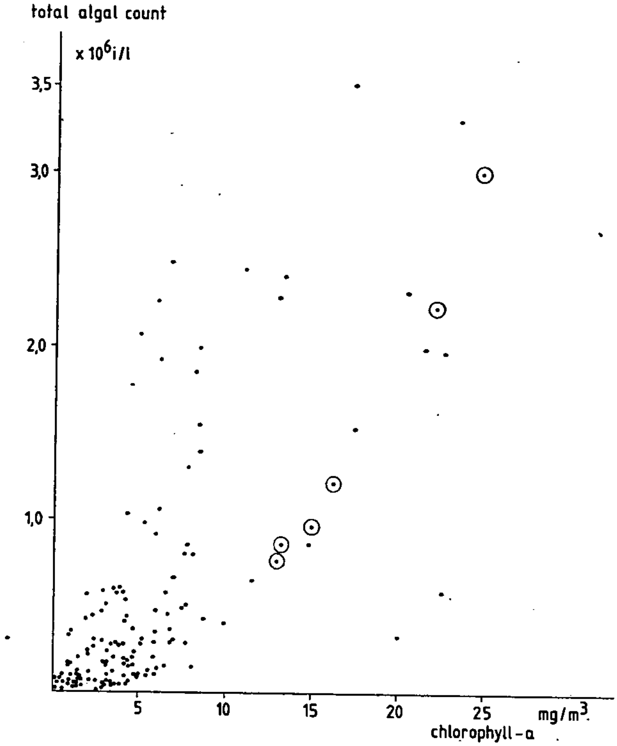

Fig. 12. Relationship between total algal count and chlorophyll-a content at the Tisza (1976—1978).

It is characteristic to the chlorophyll-a a and the total algal count relationship that in the longitudinal segment they generally change in conformity and the values are opportunely significantly decreasing. A few examples of this can be seen on Figure 11. Figure 12 also shows their relationship, which has not been complicated with the value pairs of the years 1979—1980 of similar tendency, for the sake of lucidity. It can be detected from the Figure that their connection is undistinctive in the case of small values, however, at the time of the subsiding of the algae population maximums, their relationship is unambiguous: in general, the maximums of the chlorophyll-a a and the total algal count belong together.

Practically, therefore, the trophity of the Tisza may show extreme changes, but even on the basis of those mentioned so far, the high trophity-degree in the section between Tokaj and Tiszafüred — referring to the river's eutrophizing condition — can also be regarded as characteristic. Nevertheless, it is thought-provoking that the chlorophyll-a determining method used in the water conservancy practice does not take into consideration the quantity of pheophytins being present in smaller-larger amounts — and being in relationship with the physiological state of the algae. As a consequence, on the basis of our measurement results so far, the actual trophity-— degree was overestimated in one part of the cases. To eliminate this in the future, pheophyte-measurements were started in 1982 with experimental nature, and these will be continued regularly in the forthcoming years. (The evaluation of the few results gained so far was naturally not taken into consideration in this paper.)

Returning to the nutriments, let's study their participation ratio compared to each other in the water of the Tisza. It had been determined on the basis of a large amount of measurements that for the algae that nutriment (=medium, here: the Tisza water) is the most favourable, in which the C:N:P ratio=106:16:1. Counting an average from the results of every measurement, this ratio in the bed-section of the Tisza between Tokaj and Tiszafüred was found to be 2000:120:1, rounded off. This means that compared to the participation ratio of the dissolved reactive phosphorus — which is the determinative factor for algal increase — the participation ratio of C is close to 20-folds and that of N is over 7-folds. Under such circumstances, it is natural that from the nutriments, the dissolved reactive phosphorus would become exhausted the soonest, followed by nitrogen, and carbon being the last. Between the two 5-year-periods, there are no basic differences in the C:N:P ratio, but comparing the certain years in the function of time, a slight increase can be observed in the participation ratio of N; at the same time, that of C is decreasing. The explanation to this may probably be in the increase of the NO_3^- content. This shift in ratio is also effective in the longitudinal segment: compared to Tiszatardos, the participation ratio of N manifests a significant increase in the Tiszakeszi segment.

Saprobity: on the basis of the standard values of the biologically accessible organic matter content (=COD_p) (causing saprobity), the biologically accessible organic matter quantity is not significant in the water of the Tisza. Contrary to this, the values of the saprobe-index (="S") — countable at the time of occurrence of the

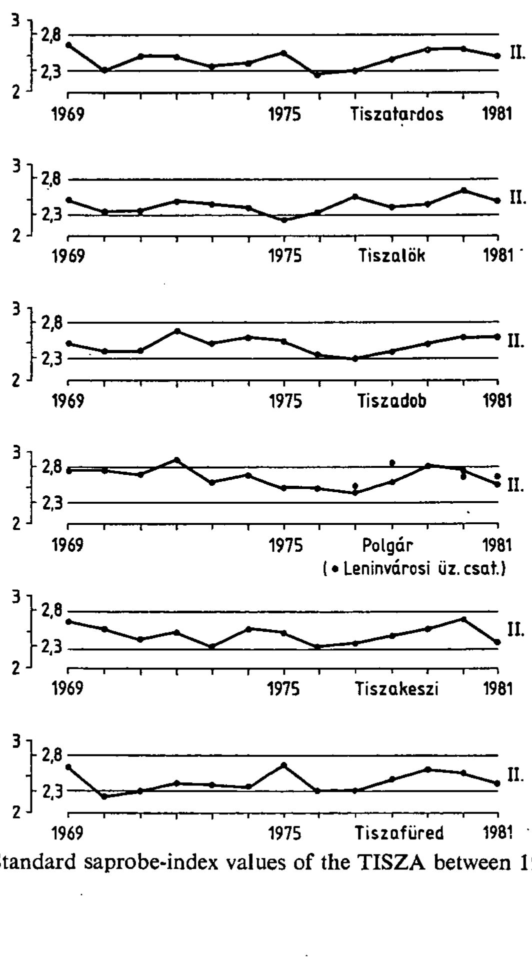

Fig. 13. Standard saprobe-index values of the TISZA between 1969—1981.

microscopic living organs — characterize more unfavou rable water quality in general; the standard saprobity was found to be of nature between betamesosaprobic — alpha-mesosaprobic, which is well illustrated on Figure 13. The changes are not unambiguous in time; in the longitudinal segment the saprobity-increase is noteworthy, experienced during the inflow of the Sajó. The dissolved oxygen content and accordingly, the oxygen saturation also characterize more unfavourable conditions. The maximum values of the dissolved oxygen content between 1969—1978 were found to be low, however, they showed noteworthy decrease in certain segments of the studied bed-section. This is also manifested in the case of the minimums, first of all in the recent years. In longitudinal segment the most characteristic change was the decrease in oxygen content, experienced in general during the inflow of the Sajó.

Nevertheless, it is found to be characteristic by the author that between the two segments selected for the comparison — Tiszatardos and Tiszakeszi — there are no great characteristic differences; the variations are not unambiguous.

Toxicity: on the basis of our studies so far — disregarding a few outstanding cases: extreme water pollution or flood periods — the water of the Tisza is not of toxic quality. Factors determining the water quality of the Tisza.

On the basis of the study results evaluated at the time of the compiling of the essay, the most important factor determining water quality is regarded to be the water output. The tables and diagrams unambiguously prove that the increase in quantity of the evaluated water quality characteristics is in tight relationship with the increase in water output. At the same time, the changes in concentration — with a few exceptions — do not show connection with the water output, although it would be expected — even considering the abrupt pollutions — that with the increase in water output there would be a decrease in the concentration of the contaminating material, too. (In case of the Tisza author finds the possibility unfeasible according to sense that the sources of contamination — mostly settling in the district waters — could regulate their contaminating activity in correlation with the water output). According to author's opinion the "loading"-increase is firstly originated from the washing ins. The connection of the TFM and water output, as well as the TFM and COD_k "loading" relationship prove that at the time of the increase in water output the Tisza washes in the soil layers rich in organic matters and nitrogen-containing fertilizers from the flood areas and the cultivated areas. This becomes evident when taking into consideration those reported in the foregoings: the NO_3^-, the COD_p and the COD show a tendency of significant increase; while the changes in NH_4^+, BOD_5 and TDM are of slighter degree or are not characteristic (Fig. 14). Nevertheless, in the case of the Tisza, it is favourable that even the dissolved oxygen content is dependent on the water output in a proportional ratio, which is well demonstrated on Figure 15.

From the other factors determining the water quality the most characteristic are the contaminants of the Leninváros area, and the Sajó:

Regarding the common effect of the contaminants in the Leninváros district, the followings are worthy of mentioning: the slightly increasing tendency of the discharged sewage amount (in 1970: 0,967 m^3/s; in 1980: 1,257 m^3/s) is followed by the increase in the amount of certain contaminating material (COD_k, TDM, NO^3); at the same time, the amount of other contaminating material (e. g. NH_4^+) shows a significant decrease. The fact should be regarded as a noteworthy result that compared to the period between 1971—1975, the joint amount of the mineral nitrogen forms (NH_4^+ — NO_2^- — NO_3^-) expressed in N decreased in the period between 1976—1980.

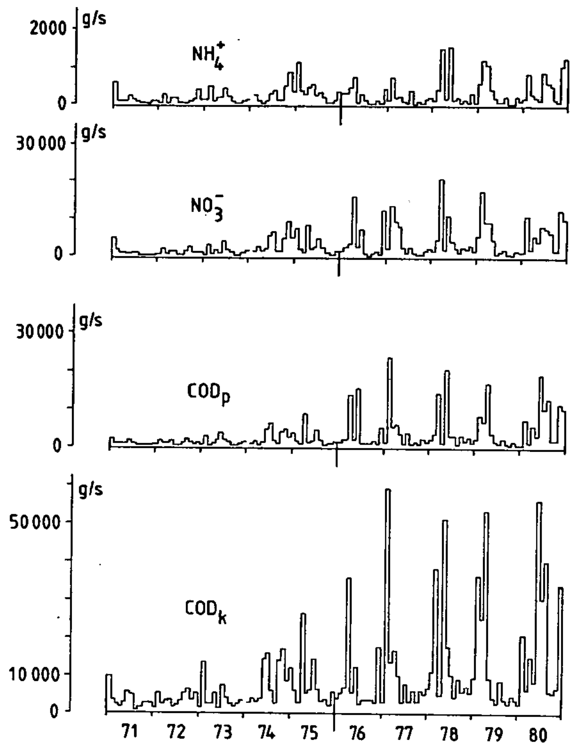

Fig. 14. Changes in the water quality characteristics of the TISZA in the function of water output at Tiszatardos.

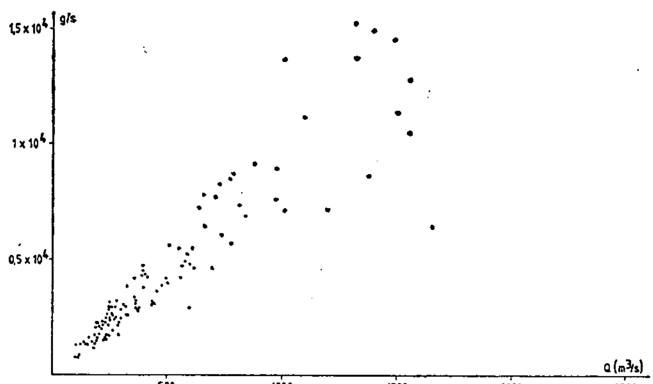

Fig. 15. Relationship between water output and O_2 amount at Tiszatardos between 1971—1980.

The degree of the decrease — expressed in nitrogen — is 25% meaning, that contrary to the 1083 t/year average values of the period between 1971—1975, the average reaching the Tisza between 1976—1980 was 802 t/year mineral nitrogen: that is, 281 t/year less amount of nitrogen loads the Tisza today.

The effect of the Sajó on the Tisza demands a separate essay, which is hoped to be prepared soon. Although it is not author's task to evaluate the Sajó, the most characteristic features should not be left unconsidered:

— on the basis of the studies between 1971—1980 the Sajó delivered an average of 5—10 g/m^3 mineral nitrogen into the Tisza, which appeared there in a well demonstrable form: comparing the values of Polgár and Tiszakeszi the surplus was averagely 0,5—1,0 g/m^3 N. Therefore, the Sajó significantly contributed to the increase in nitrogen-"loading" at the Tisza bed-section during the inflow;
— in the Sajó the C:N:P ratio gradually comes close to the ideal towards the mouth, but its average value even there can be characterized by the 5-folds "surplus" of C and N;
— its chlorophyll- a content shows extreme variety, its amount is determined by the Hernád chlorophyll- a content;
it is characteristic to the mineral nitrogen content that its concentration is low (under 10 g/m^3) in the water flowing in from the border, under the BVK, however, the maximum may even be above 50 g/m^3, and before the mouth it may even decrease to a value of 15 g/m^3 due to the dilution. Nevertheless, its amount (="loading") does not decrease from Sajószentpéter to Kesznyéten, moreover — first of all on the effect of the sewages from the city Miskolc — it can be characterized by values of increasing nature. This refers to the fact that in the Sajó, the certain nitrogen-forms may become transformed, nevertheless, they do not leave from there. The cause of this is unclear as yet.

* * *

1. The water quality of the Tisza at the section between Tokaj and Tiszafüred is acceptable in general, although there are also results characteristic of unfavourable conditions.
2. The water quality of the Tisza is fundamentally determined by the water output; simultaneously with its increase, the amount of the biologically available nutriments will also become higher. At the same time, it should not be disregarded that between the period 1971—1980, the utilization of chemical fertilizers containing N and P effective agents substantially increased, which has decisive influence on the development of the nutriment concentrations and their loading, respectively.
3. From the property-groups of the biological water quality, the halobity and toxicity are favourable and can practically be characterized by balanced values in the studied period. The trophity shows extreme changes in the function of seasons, it may even surpass the degree characteristic to the eutrophic state at the end of Summer — Autumn (occasionally in Spring). In contrast to the 106:16:1 ratio of carbon-nitrogen-phosphorus regarded as favourable for the algae, this value is 2000:12:1 in the Tisza. The saprobity shows relatively balanced changes, however, — especially the change in time of O_2 content — it rather indicates a shift towards unfavourable direction.
4. It is noteworthy that between the two 5-year-periods the increase in COD_k concentration at the Tiszatardos segment is essentially higher than at the Tiszakeszi segment. Its cause is thought to be in the sedimenting effect of the banked up bed-section above Tiszalök, which could only be proved by the measuring of the residuum originating from the alluvial deposit.
5. On the contrary, the NO_3^- content increased in higher degree in the segment of Tiszakeszi compared to Tiszatardos. The cause of this is firstly seen in the fact that the washing ins originating from the areas belonging to the bed-section between the two segments are added to the amount brought from above, nevertheless, the casual effect of the Sajó cannot be neglected either.

On the basis of the afore-mentioned, the followings are thought to be expedient:

Table 1. *Annual changns in thn water quality indexes (g/m^3) in the two profiles.*

Table 1	COD_P		COD_K		BOD_5		TDM		O_2		NH_4^+		NO_3^-	
	U	L	F	A	F	A	F	.	F	A	F	A	F	A
1971 min.	2,8	2,9	6,7	8,4	1,1	2,0	205	190	7.1	6,2	0,35	0,20	2,0	3,0
max.	5,2	5,9	17,0	21,6	8,8	7,7	290	360	11,5	13,3	0,75	2,10	6,5	7,0
average	3,8	4,3	12,3	15,5	3,3	4,3	239	274	8,9	9,4	0,49	0,98	3,8	4,9
1972 min.	2,8	4,4	7,6	15,5	2,1	3,0	174	190	6,7	7,1	0,20	0,36	2.8	3,2
max.	5,0	8,0	17,6	28,4	3,9	7,8	253	352	12,4	12,1	1,58	1,70	6,0	6,5
average	3,8	5,7	12,7	19,4	3,0	4,5	218	255	8,9	9,4	0,48	0,77	4,1	4,8
1973 min.	2,9	4,2	6,1	13,9	2,1	2,0	171	184	6,6	6,7	0,20	0,15	2,2	3,2
max.	5,8	15,0	20,8	33,3	3,4	3,9	306	360	11,8	12,1	1,14	2,20	7,0	7,5
average	4,2	7,1	13,9	21,7	2,6	3,2	232	271	9,3	9,4	0,54	0,94	4,6	5,6
1974 min.	2,4	3,5	9,3	12,8	2,0	1,9	149	174	6,1	5,6	0,20	0,40	3,8	4,8
max.	5,7	14,9	18,8	39,8	3,6	4,1	272	309	12,6	11,7	1,47	1,55	8,0	8,5
average	3,9	6,7	12,2	20,9	2,7	2,9	209	232	9,3	9,0	0,51	0,82	6,0	6,9
1975 min.	2,1	3,0	9,0	11,0	2,0	2,4	152	157	4,9	6,3	0.10	0,49	3,6	2,8
max.	8,0	11,8	24,0	34,0	4,3	4,8	351	395	12,9	12,3	1,40	2,55	8,0	10,0
average	4,0	6,2	14,6	20,1	3,0	3,1	272	296	9,1	8,8	0,73	1,10	5,4	6,5
1976 min.	3,1	4,8	9,4	11,6	1,4	1,9	141	138	7,8	5,2	0,10	0,35	2,8	4,0
max.	15,7	14,1	20,0	42,0	3,2	4,0	280	322	11,4	11,2	1,25	1,65	14,0	12,0
average	5,5	6,7	13,9	21,7	2.7	2,8	224	254	9,4	9,0	0,47	1,01	6,0	6,9
1977 min.	3,6	4,2	10,9	11,1	1,2	2,5	166	178	7,0	6,6	0,15	0,25	3,0	4,6
max.	14,0	13,0	35,0	34,0	3,6	5,2	263	304	11,8	11,5	0,65	1,35	8,0	10,5
average	5,5	5,9	16,5	18,0	2,8	3,3	215	249	9,4	9,2	0,38	0,70	5,5	7,0
1978 min.	3,2	4,2	11,0	14,6	1,7	1,7	175	201	6,6	6,4	0,20	0,45	4,2	4,8
max.	14,5	13,4	34,2	29,1	3,8	5,8	313	343	11,3	11,7	1,05	1,80	8,4	12,5
average	5,8	6,9	19,1	21,7	3,0	3,3	247	272	9,1	9,2	0,49	1,05	5,6	7,7
1979 min.	2,9	4,1	9,9	13,0	1,7	2,4	185	193	6,7	5,9	0,15	0,30	3,2	5,0
max.	9,8	7,5	30,8	24,5	4,8	5,8	324	366	11,8	11,2	0,80	1,20	8,5	16,0
average	5,0	5,9	17,5	19,9	3,4	3,7	244	274	9,4	8,9	0,48	0,74	5,5	7,6
1980 min.	4,2	4,6	13,2	14,8	1,9	2,5	202	187	3,9	4,7	0,25	0,20	4,0	4,4
max.	16,3	10,4	46,9	56,7	6,3	6,5	326	318	11,8	11,3	1,30	2,20	14,0	15,0
average	7,5	7,3	24,3	26,1	3,9	4,5	247	256	8,9	8,6	0,67	0,90	7,0	8,1

Table 2. *Total annual changes of the water qualty indexes and comparison of the лesults of the two five year's periods in the area of Tiszatardos*

Table 2	ΣQ	COD_p		COD_k		BOD_5		TDM		O_2		NH_4^+		NO_3^-	
	[m^3/s]	ΣC [g/m^3]	$\Sigma(C \cdot Q)$ [g/s]	ΣC [g/m_3]	$\Sigma(C \cdot Q)$ [g/s]	ΣC [g/m^3]	$\Sigma(C \cdot Q)$ [g/s]	ΣC [g/m^3]	$\Sigma(C \cdot Q)$ [g/s]	ΣC [g/m^3]	$\Sigma(C \cdot Q)$ [g/s]	ΣC [g/m^3]	$\Sigma(C \cdot Q)$ [g/s]	ΣC [g/m^3]	$\Sigma(C \cdot Q)$ [g/s]
1971	3 271	45,0	11 628	147,6	34 358	40,0	10 029	2 863	745 188	106,2	30 318	5,91	1 762	45,5	13 894
1972	3 697	45,6	13 883	152,1	45 577	35,7	10 921	2 612	786 435	107,3	32 885	5,72	1 763	48,7	15 079
1973	4 221	50,8	17 742	166,7	48 814	31,1	10 564	2 786	896 653	111,4	39 417	6,49	2 259	54,8	19 711
1974	7 730	46,5	31 186	146,7	95 182	32,4	20 122	2 514	1 546 670	112,0	69 483	6,16	3 474	71,7	44 964
1975	6 464	48,6	28 762	174,7	94 694	36,0	19 497	3 265	1 538 980	109,7	59 027	8,77	4 342	64,6	36 296
T 1971—75	25 383	236,5	103 201	787,8	318 625	175,2	71 133	14 040	5 513 926	546,6	231 130	33,05	13 600	285,3	129 944
1976	7 361	66,5	47 293	167,2	104 108	32,0	18 839	2 692	1 431 056	112,7	70 376	5,65	3 059	72,3	51 476
1977	7 167	66,2	50 393	198,2	137 106	33,2	20 375	2 579	1 469 040	112,6	68 542	4,60	2 614	66,2	45 241
1978	8 621	69,5	58 361	229,8	171 591	36,6	26 644	2 959	1 945 962	108,9	77 792	5,90	5 019	67,2	56 278
1979	8 612	60,0	45 214	210,1	164 187	40,4	28 009	2 930	1 979 299	112,7	87 307	5,75	4 366	65,4	54 731
1980	10 200	89,8	86 801	291,3	230 909	46,6	40 717	2 963	2 361 917	106,3	83 017	8,07	6 336	84,4	70 901
T 1976—80	41 961	352,0	288 062	1096,6	807 901	188,8	134 584	14 123	9 187 274	553,2	387 034	29,97	21 394	355,5	278 627
A 1971—75	423	3,9	1 720	13,1	5 310	2,9	1 185	234	91 899	9,1	3 852	0,55	227	4,7	2 166
A 1976—80	699	5,9	4 801	18,3	13 465	3,1	2 243	235	153 121	9,2	6 450	0,50	357	5,9	4 644
±%	+65	+51	+179	+40	+153	+7	+89	+0,5	+67	+1	+67	−9	+57	+25	+114

a) studies should be carried out on the pollutions originating from the washing ins at the periods of floods; b) including studies at the longitudinal segments, which should be carried out regularly at various water levels — at least in certain characteristic channel sections —; c) furthermore, studies should be performed at least seasonally on the constituents of the oxygen-circulation, applying uniform methods. At the same time author finds it inevitable to carry out studies regularly on the organic nitrogen and the pheophytins at the most significant segments of the Tisza's whole Hungarian channel section.

Used abbreviations:

NO_3^-	nitrate-ion
COD_p	chemical oxygen demand (with $KMnO_4$)
COD_k	chemical oxygen demand (with $K_2Cr_2O_7$)
NH_4^+	ammonium-ion
BOD_5	"biochemical oxygen demand" (of 5 days)
TDM	total dissolved matter
TFM	total floating matter
O_2	dissolved oxygen
Ca^{++}	calcium-ion
HCO_3^-	hydrogen/carbonate-ion
CO_2	carbon dioxide
U	Tiszatardos (upper segment)
L	Tiszakeszi (lower segment)
1	1971—1975 (first 5-year-period)
2	1976—1980 (second 5-year-period)

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A Tisza biológiai vízminősége Tokaj—Tiszafüred között 1971—1980. évi vizsgálatok alapján

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Kivonat

Tanulmányomban a Tisza két jellemző szelvényében (Tiszatardos és Tiszakeszi) 1971—1980 között végzett vízminőségvizsgálatok eredményeit hasonlítottam össze. Az értékelt tízéves időszak alapvetően eltérő vízmennyiségekkel jellemezhető ötéves időszakra tagolható: 1971—1975 között többnyire 500 m^3/s alatti; 1976—1980 között 500 m^3/s feletti, számos alkalommal 1000 m^3/s-ot is lényegesen meghaladó értékekkel jellemezhető.

A két ötéves időszak összehasonlító értékelése egyértelműen arra utal, hogy a Tisza vízminőségét alapvetően a vízhozam határozza meg, amelynek növekedésével egy időben nagyobb lesz a biológiailag hozzáférhető tápanyagok mennyisége is!

Az értékelt vízminőségi jellemzők alapján megállapítható, hogy mindkét szelvényben jelentékeny romlás következett be, amely Tiszakeszi szelvényében kifejezettebb, mint Tiszatardos szelvényében. Oka elsősorban a két szelvény közötti mederszakaszhoz tartozó területekről származó bemosódásban lehet.

Биологическое качество воды Тисы на участке между Токай — Тисафюред на основе проведенных в 1971—1980 гг. исследований

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Резюме

Автор работы сравнивает результаты анализа качества воды двух характерных отрезков Тисы (Тисатардош и Тисакеси), проведенного в 1971—1980 гг. Анализируемый десятилетний период по различной массе воды может быть разделён на два периода: 1971—1975 гг., когда масса воды была чаще всего ниже 500 м³/сек., и 1976—1980 гг., когда масса воды была выше 500 м³/сек, а нередко и превышала 1000 м³/сек.

Сравнительная оценка двух пятилетних периодов ясно показывает, что качество воды Тисы определяется в основном притоком воды, с увеличением которого одновременно увеличивается и количество биологически доступных питательных веществ.

На основе анализируемых показателей качества воды можно установить, что на обоих отрезках наблюдается значительное худшение качества воды, особенно на отрезке Тисакеси. Причину этого следует искать, вероятно, в первую очередь, в смыве с территорий, находящихся между отрезками русел двух участков.

Kvalitet vode Tise na deonici Tokaj—Tiszafüred u periodu 1971—1980.

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Abstrakt

U saopštenju su poredjeni rezultati ispitivanja kvaliteta vode za period 1971—1980. godine sa dve deonice Tise (Tiszatardos i Tiszakeszi). Istraživano 10-to godišnje razdoblje, u odnosu na vodenu masu, odlikuje se sa dva petogodišnja perioda: 1971—1975. ispod 500 m³/s i 1976—1980. iznad 500 m³/s, povremeno čak sa vrednostima iznad 1000 m³/s.

Uporedna analiza ova dva petogodišnja perioda jednosmisleno ukazuje na činjenicu da je kvalitet vode Tise us osnovi odredjen vodenom masom, čijim se povećanjem istrovremeno povecavaju i biološki dostupne hranljive materije.

Na osnovu analiziranih parametara utvrdjeno je da je na obe deonice došlo do značajnog pogoršanja kvaliteta vode, što je na deonici Tiszakeszi izraženije nego na deonici Tiszatardos.

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RELATIONSHIP BETVEEN THE CHEMICAL OXYGEN DEMAND, SUSPENDED MATTER CONTENT AND ALGAL COUNT IN THE EASTERN MAIN CANAL (HUNGARY)

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Abstract

The Eastern Main Canalis a 100 km long artificial stream conducted from the Tisza river at Tiszalök (535 river km) with the rate of flow 30—50 m^3/s. The investigations were carried out in the Eastern Main Canal at the section between Tiszalök and Balmazújváros 1968—1975. The amount of suspended matter changed from 5—700 mg/l, the values of chemical oxygen demand (COD) varied from 3—15 mg/l and that of the algal count from 30 thousand — 20 million individuals per liter. The changes of theese values depended on the floods of the Tisza river and on the current velocity of the Eastern Main Canal.

The present paper wishes to report on the degree to which the COD values were altered by the suspended matter content, and modified by the algal count, respectively (here, that organic material of suspended matter and algae should be taken into account, which are oxidizable in acidic with potassium permanganate, since the suspended matter also comprises the algae). With the help of path-analysis it was concluded that in case of high suspended matter content — when the algal count is low — the COD is determined by the amount of suspended matter in 40—70%, and by the algal count in 0,5—0,6%. Besides low suspended matter content — when the algal count is high — the values of the chemical oxygen demand are determined in 4—10% by the amount of suspended matter content, and in 15—20% by the algal count.

Introduction

Apart from the dissolved organic matter, the chemical oxygen demand of flowing waters is determined by the formed (living, dead) organic matter of the suspended matter. The suspended matter content in river waters — which substantially increases at the time of floods — manifests essential influence on the chemical oxygen demand. In the case of the Hungarian rivers this had been analysed by several authors (PÁSZTÓ 1963, ÁDÁMOSI et *al.* 1974, VÉGVÁRI 1976, 1977, KOZMA 1976—77, ÁDÁM M., VÁRDAY 1977, BANCSI et *al.* 1978). As the consequence of the enhancing eutrophization of the rivers, phytoplankton communities of high individual number (several million ind/l) appear in the low-water periods. In such case the biomass of the phytoplankton increases the organic matter content of the water to such an extent that its effect on COD is well demonstrable (VÖRÖS 1976).

Parallel with the regular algal studies at the Eastern Main Canal between 1968—1975, the analysis of a few chemical parameters was also performed (KISS, K. T. et *al.* 1974, KISS, K. T., TÓTH 1975). The quantity changes of certain components as well as the development of the quantity relations of the phytoplankton communities stand connection with each other. Here we will report on the relationship between the chemical oxygen demand, the suspended matter content and the algal count.

Methods of sampling and analysis

For the chemical and algological examinations the water samples were taken weekly at Tiszalök (0,4 riv. km), Tiszavasvári (4,7 riv. km) and Balmazújváros (44,5 riv. km), from beneath the water surface, from the current line. Taking into account the current velocity of the Eastern Main Canal, the sampling at Balmazújváros was accomplished 2—7 days following the samplings at Tiszalök and Tiszavasvári, so that according to possibility the water samples would originate from the same mass of water. The water samples taken from the Eastern Main Canal at Tiszalök could be regarded as Tisza-water, since the water of the redammed up bed-section of the Tisza river at Tiszalök reaches this sampling place without any difficulty. More detailed data on the sampling places and the used methods can be read in the earlier papers by KISS, K. T. (1974*b*, 1975).

The suspended matter content and the chemical oxygen demand (COD) measured in acidic medium with potassium permanganate were determined according to the instructions of FELFÖLDY (1974). The quantitative analysis of the phytoplankton communities was carried out using the method of UTERMÖHL (LUND et *al.* 1958). The correlation calculation and path-analysis were carried out on the basis of the average data of the monthly 4 samplings (SVÁB 1973).

Results

The suspended matter content of the Eastern Main Canal depends on the floods of the Tisza river and the water amount supplied through the lock at Tiszavasvári. In general, more seston is found in the water at the Tiszalök—Tiszavasvári section than at Balmazújváros (Fig. 1). If there is no flood at the Tisza river, the suspended matter content in Winter in the frozen canal water is 5—6 mg/l, which may rise to several hundred mg-s on the occasion of floods in Spring and early Summer (KISS, K. T. et *al.* 1974.). With the subsiding of the floods the water becomes settled in the periods at the end of Summer — early Autumn, and the seston amount decreases to 20—30 mg per liter. Algal communities with large species- and individual numbers appear in the settled water and the development of phytoplankton blooms can frequently be observed (KISS, K. T. 1974a, b, 1975).

The chemical oxygen demand of the water at the Eastern Main Canal generally ranges between 4—6 mg/l. The lowest values (2,2—2,5 mg/l) were measured in Winter at the icecovered Main Canal at Balmazújváros, and in the August period at Tiszalök, respectively. At the time of the floods in Spring and early Summer there is a rise in the COD value, which is firstly the result of increased seston-quantity of the water. During the course of our studies so far, the highest values were measured in 1970 on the occasion of the great flood at the Tisza river (May 18, 1970; Tiszalök 781 mg/l). Advancing from Tiszalök towards Balmazújváros the chemical oxygen demand shows a decrease in general, which can first of all be brought into connection with the decrease in seston content.

The correlation between the suspended matter content and the chemical oxygen demand can be approached the most precisely with a linear equation (Fig. 1).

Correlation coefficient values:

At Tiszalök	r=0,7076 (significant at 0,1 %)
At Tiszavasvári	r=0,6849 (significant at 0,1 %)
At Balmazújváros	r=0,3130 (significant at 3,0%)

Equation of linear regression:

At Tiszalök	$Y'=3{,}86+0{,}0110\,x$
At Tiszavasvári	$Y'=3{,}58+0{,}0113\,x$
At Balmazújváros	$Y'=3{,}50+0{,}114\,x$

It can be determined from the regression equation, the measured data, as well as from Figure 1, that the higher suspended matter content values come nearer to the straight line obtained on the basis of the regression equation than the values of

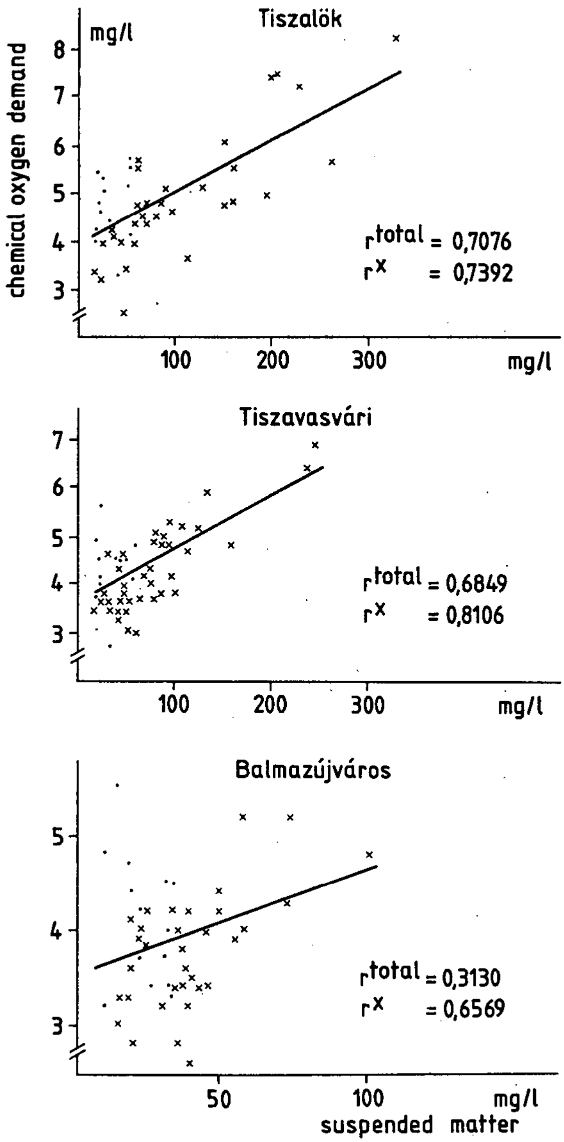

Fig. 1. Correlation between the suspended matter content and the chemical oxygen demand (the values belonging to the higher suspended matter content — lower algal count are indicated by x; interpretation is given in the text).

the low suspended matter content. The cause of this ist hat by low suspended matter content, the COD is influenced by the number of plankton algae, and in periods with high suspended matter content rather by the abioseston. In the interest of proving this assumption, further calculations were carried out.

The coefficient values of the Brawais' correaltion between the COD and the algal count are:

The coefficient values of the Bravais' correaltion between the COD and the algal count are:

At Tiszalök	r=0,0084
At Tiszavasvári	r=0,1109
At Balmazújváros	r=0,3077

According to the correaltion coefficients there is no relationship between the algal count and COD at the upper canal section, and the correaltion is very loose at Balmazújváros.

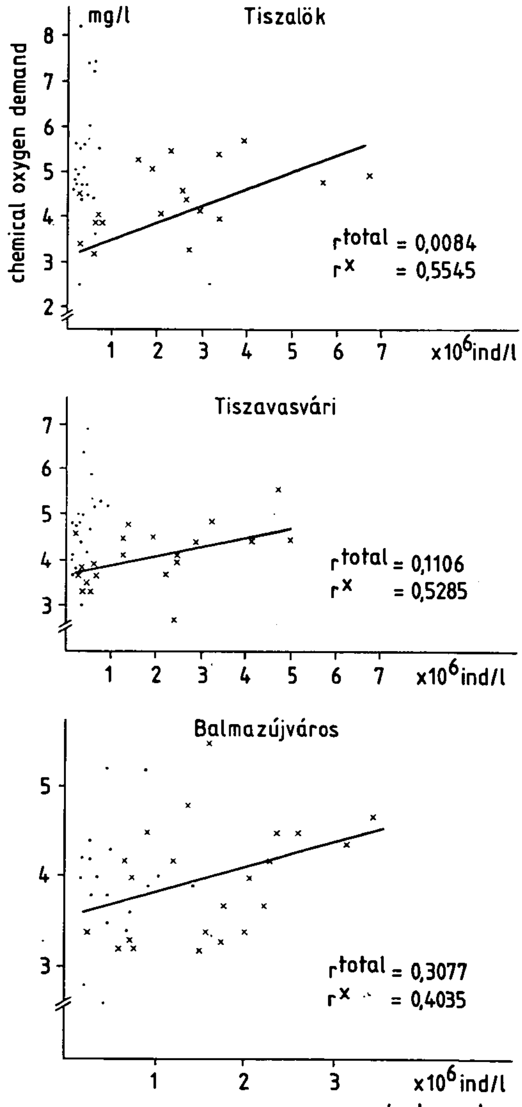

Fig. 2. Correlation between the algal count and the chemical oxygen demand (the values belonging to the lower suspended matter content are indicated by x, the equation of the straight line was also calculated on this base and the straight line was drawn accordingly; interpretation is given in the text).

It is striking firstly on the basis of the data gained from Tiszalök that the COD values belonging to the algal number lower and higher, respectively, than 1 million ind./l are separated from each other (Fig. 2). Namely, the essence of the correlations pisnedout better if the correlation ccul itoalatinos aer accomplished with t edahat

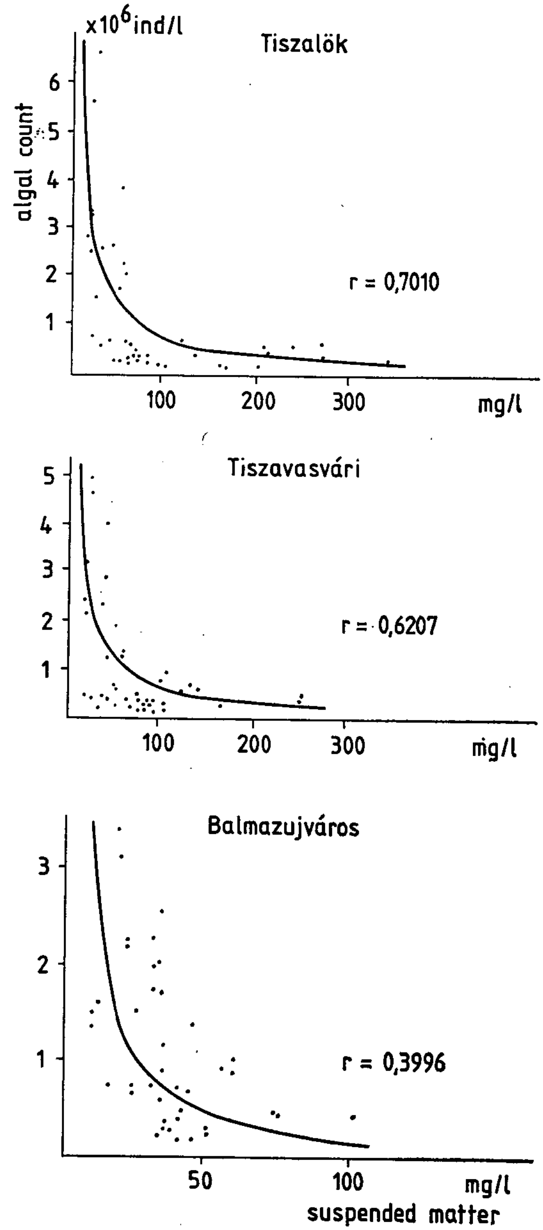

Fig. 3. Correlation between the suspended matter content and the algal count.

standing below and above this limit value, respectively. The result of this is the following (the r_{total}=correlation coefficient) counted on the basis of the total data):

At Tiszalök:

<1 million ind./l	r=0,2061	(r_{total}=0,0084)
>1 million ind./l	r=0,5545	(significant at 1,5 %)

At Tiszavasvári:

<1 million ind./l	r=0,3334	(r_{total}=0,1109)
>1 million ind./l	r=0,5285	(significant at 1,5 %)

At Balmazújváros:

<1 million ind./l	r=0,0658	(r_{total}=0,3077)
>1 million ind./l	r=0,4035	(significant at 6,5 %)

It can be concluded that there is no relationship between the algal count and the COD — or it is very loose, resp. — in the case of algal numbers lower than 1 million ind./l. When the algal number is higher than 1 million ind./e the correlation is moderate. The relationship is all the tighter, the higher the algal number. This is the reason why the tightness of the correlation decreases from Tiszalök towards Balmazújváros.

The distinguishing of these two provinces is by all means reasonable even when

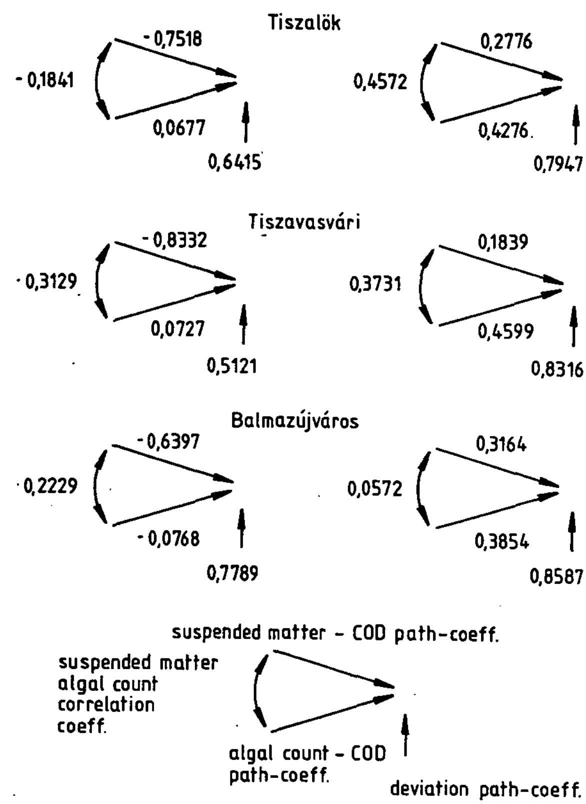

Fig. 4. Path-diagram of the correlation between the suspended matter content, the algal count, and the chemical oxygen demand (the left column comprises the larger suspended matter domain, and the right column the smaller suspended matter domain).

studying the relationship between the suspended matter content and the chemical oxygen demand. The mode of distinction was by finding on the joint diagram of the suspended matter content and algal count that suspended matter limit value, above which the algal count doesn't rise — or only rarely — rises over 1 million ind./l. This limit was found to be 60 mg/l suspended matter content at Tiszalök and Tiszavasvári, and 35 mg/l at Balmazújváros (Fig. 3). Performing the correlation calculations according to this, the following results were obtained:

At Tiszalök:
>60 mg/l $r=0{,}7392$ (significant at 0,1%)
<60 mg/l $r=-0{,}0820$ ($r_{total}=0{,}7076$)
At Tiszavasvári:
>60 mg/l $r=0{,}8106$ (significant at 0,1%)
<60 mg/l $r=-0{,}0123$ ($t_{total}=0{,}6849$)
At Balmazújváros:
>35 mg/l $r=0{,}6569$ (significant at 0,5%)
<35 mg/l $r=-0{,}2937$ ($r_{total}=0{,}3130$)

It can be concluded on the basis of the correlation coefficients that besides suspended matter content higher than 60 and 35 mg/l, resp. (algal count lower than 1 million ind./l) the correlation is tighter than in case of r_{total}. This is particularly striking at Balmazújváros. In the case of suspended matter content lower than 60 and 35 mg/l, resp., (algal count higher than 1 million ind./l) there is no relationship between the suspended matter content and the chemical oxygen demand, or it is very loose and of negative tendency.

To decide the degree to which the chemical oxygen demand is influenced by the suspended matter content and the algal count, furthermore, to determine the degree of the common effect of these, path-analysis was carried out (applying the "r" values of the above distinguished two value domains). The values of the path-coefficients are demonstrated on Figure 4. Only the disintegration of the R^2 multiple determination coefficient is presented in detail, with the help of the following Table. (p_1^2=suspended matter — COD determination coefficient; p_2^2=algal count — COD determination coefficient; P_{ind}=suspended matter+algal count — COD path-coefficient; P_e=determination coefficient of other, not studied effects):

	At Tiszalök		At Tiszavasvári		At Balmazújváros	
	>60 mg/l	%	>60 mg/l	%	>35 mg/l	%
p_1^2	0,5652	56,5	0,6942	69,4	0,4093	40,9
p_2^2	0,0046	0,5	0,0053	0,5	0,0059	0,6
p_{ind}	0,0187	1,9	0,0379	3,8	0,0219	2,2
p_e	0,4115	·41,1	0,2626	26,3	0,5848	58,5
		100,0		100,0		100,0
	<60 mg/l	%	<60 mg/l	%	<35 mg/l	%
p_1^2	0,0770	7,7	0,0338	3,4	0,1001	10,0
p_2^2	0,1829	18,3	0,2115	21,2	0,1486	14,9
p_{ind}	0,1085	10,9	0,0633	6,3	0,0140	1,4
p_e	0,6316	63,1	0,6916	69,1	0,7373	73,7
		100,0		100,0		100,0

On the basis of the Table it can be concluded that at the upper canal section by suspended matter content more than 60 mg/l, the suspended matter content has the decisive role in the values of the chemical oxygen demand (56—69%). The effect of the algal count is negligible, and even the indirect effect is not essential. Other cffects influencing the COD have a role in 26—41%. In the smaller suspended matter content domain the direct effect of the suspended matter in low (3—7%). The algal eount determines the COD in 18—21%, and the indirect effect should not be neglected either (6—10%). The role of other non-studied effects becomes considerable, in whole becoming determinative (63—69%).

At Balmazújváros the role of p_1^2 is substantial the larger suspended matter domain (40%), but is not so considerable as at the upper canal section. The effect of the algal count and also the indirect effect are both negligible, since here, it is the other effects which play decisive role. In the smaller suspended matter domain the value of COD is determined by the algal count in 14%, and by the amount of suspended matter in 10% (in whole this is almost as high as the effects of the suspended matter and the algal count at the upper canal section). The indirect effect is insignificant (lower than at the upper section). The other effects become determinative (73%).

Summarising, it can be concluded that the effect of the suspended matter content is the most important in the development of the COD amount by high value of suspended matter content. The decisive role of the algal count comes into the foreground by lower suspended matter content nevertheless, the other effects play a more important role after all, than the studied factors.

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A kémiai oxigénigény, a lebegőanyag-tartalom és az algaszám összefüggése a Keleti Főcsatornán

KISS K. T.

Magyar Dunakutató Állomás Göd

Kivonat

A Keleti Főcsatorna Tiszalök—Balmazújváros közötti szakaszán 1968—75. között, a hetenkénti mintavételek eredményei azt mutatták, hogy a víz lebegőanyag-tartalma 5—6 mg-tól 500—700 mg-ig, a kémiai oxignéigény (KOI_{sMn}) értékei 3—15 mg között, az algaszám 30—50 ezertől 15—20 millió egyedig változott literenként.

Dolgozatunkban azt kívántuk bemutatni, hogy a KOI értékeket milyen mértékben alakította a lebegőanyag-tartalom, hogyan módosította az algaszám. Path-analízist végezve megállapítottuk, hogy nagy lebegőanyag-tartalom esetén — amikor kicsi az algaszám — a KOI-t 40—70%-ban a lebegőanyag mennyisége, 0,5—0,6%-ban az algaszám határozta meg. Kis lebegőanyag-tartalom mellett — amikor nagy az algaszám — a kémiai oxigénigény értékeit 4—10%-ban a lebegőanyag-tartalom mennyisége, 15—20%-ban az algaszám határozta meg. Nagy lebegőanyag-tartalomnak Tiszalök—Tiszavasvárinál a 60 mg/l, Balmazújvárosnál a 35 mg/l-nél nagyobb értékeket, kis lebegőanyag-tartalomnak az ennél kisebbeket tekintettük. Kis algaszámnak az 1 millió ind./l alatti, nagy algaszámnak az e fölötti értékeket tartottuk.

Зависимость между химической потребностью в кислороде, содержанием взвешенных веществ и числом водорослей в Восточном Главном Канале

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Резюме

Результаты проб, которые еженедельно брались из воды Восточного Главного Канала на участке между Тисалёк-Балмазуйварош в течение 1968—75 гг., показали, что содержание взвешенного материала колеблется от 5—6 мг до 500—700 мг, показатели химической потребление в кислороде (ХПК) — между 3 и 15 мг, а число особей водорослей — от 30—50 тысяч до 15—20 мил. на 1 литр.

В своей работе мы хотим показать, в какой степени влияли на ХПК содержание взвешенных веществ и количество водорослей. Проделав анализ Патх, мы установили, что в случае высокого содержания взвешенного материала и низкого количества водорослей ХПК на 40—70% определяет количество взвешенного материали и лишь на 0,5—0,6% — содержание водорослей.

В случае же невысокого содержания взвешенного материала и большого числа водорослей химическую потребность в кислороде на 4—10% определяет содержание взвешенного материала и на 15—20% — число водорослей. Высоким содержанием взвешенного материала на участке Тисалёк—Тисавашвари мы считали показатель свыше 60 мг/л, а в Балмазуйвароше — свыше 35 мг/л, низким содержанием — показатели соответственно ниже приведенных. За небольшое число водорослей принимали показатель ниже 1 мил/л, а за высокое — превышающие 1 мил. показатели.

Zavisnost broja algi, hemijske potrošnje kiseonika i lebdeće mase u Keleti Főcsatorna

KISS K. T.

Stanica za istraživanje Danuva, Göd

Abstrakt

Na deonici Istočnog Kanala (Keleti Főcsatorna) izmedju Tiszalök—Balmazújváros, u periodu 1968—1975. godine, nedeljni uzorci su pokazali da se lebdeće materije u vodi kreću od 5—6 mg do 500—700 mg, vrednosti hemijske potrošnje kiseonika (HPK) su od 4—15 mg, dok se broj algi kretao od 30—50 hiljada do 15—20 miliona jedinki po jednom litru.

U radu je prikazano u kojoj meri je lebreći materijal i broj algi uticao na HPK. Path-ovom analizom je utvrdjeno da je u slučaju velike količine lebdećeg materijala- kada su alge malobrojne — HPK je u 40—70% ovisna od lebdeće mase, a u 0,5—0,6% od broja algi. U slučaju male količine lebdećeg materijala — kada su alge malobrojne HPK u 4—10% odredjuje lebdeći materijal, a u 15—20% broj algi.

Pod velikom količinom lebdeće mase smatrali smo veće količine od 60 mg/l kod deonice Tiszalök—Tiszavasvári, a kod deonice Balmazújváros veće količine od 35 mg/l. Količinu ispod ovih vrednosti smatrali smo malom količinom lebdećeg materijala. U odnosu na količinu algi vrednost ispod jednog miliona ind/l uzeli smo kao malu brojnost, a iznad kao veliku brojnost.

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ALGOLOGICAL INVESTIGATIONS IN THE WATERS OF THE TISZA BASIN AT ALPÁR

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Abstract

The algological investigations of the waters at the Alpár basin were continued further in 1982 since the area will be a part of the Tisza—III River Barrage water-basin. During the course of the year a total of 174 species or taxon within this could be determined. Four algal blooms also occurred, and mainly through these, the role of the factors influencing the algal associations could be studied. The one-sidedly antagonistic effect of the blue algae, *Aphanizomenon flos aquae* and *Microcystis aeruginosa,* was particularly striking. The mass production of these could be manifested in every biotop. The algal blooming of *Euglena sanguinea* and *E. polymorpha* repeatedly proved that the *Euglenophyton* species are able to produce enormous mass productions in the dung-polluted waters. According to our physiological studies the cell division of *E. sanguinea* was greatly promoted by pea brew fostering soil enriched with a low amount of ascorbic acid. In the green mass production of this organism, in the region of the cell centre, 3—4 deep-red haematochrome clods were detectable in 10—15% of the individuals. These disappeared within 2—3 hours upon illumination, and reappeared on the occasion of darkening. The author of this paper as well as others have observed the occurrence of this organism in Hungary several times.

Introduction

As a part of the complex investigations started in 1982, studies on the waters of the Tisza basin at Alpár were continued further from algological point of view. Earlier, between 1975—1978, only the algal wordl at the Northern section of the backwater near the village Tiszaalpár was analysed. This was compared to the algal world of the backwater near the village Tiszaug by means of simultaneous studies (KISS 1979), since the complex evaluation can only become complete if the earlier results are also complemented with the algological studying of the other waters at this area. These circumspect studies are mainly reasoned by the fact that this area will become part of the Tisza—III River Barrage water-basin, and the management as well as rational utilization of the water-basin also require the knowledge of the former natural aspect.

In connection with the building of the water-basin the circumstance is noteworthy that certain parts of this area appear to be of sodificating nature. This was also observable by the outstanding biologist REZSŐ FRANCÉ (ROUL H. FRANCÉ), therefore, apart from the sodic waters of the pusztas of Kecskemét and Szikra, he also studied the waters of Alpár from algological viewpoint (FRANCÉ 1896). The author of this paper had also gone through these regions in 1934, and had collected water and soil samples. This was when he first heard that the people of the village Bokros used the term “cow-track” or “cattle-track” when speaking of the sodic grazing lands located near the village.

Now, an analysis will be given of two parts of the Alpár basin from algological point of view. One is the holiday resort bathing section situated around the centre of the backwater near Alpár, the other is the area of grazing land named as “cow-track”, located near the village Bokros. Two water dips extend over the “cow-track” area. One is the long dip range, roughly having a strike direction towards north-east — southwest, which area is mentioned by those living there as ”longplain”. The other joins to the north-western end of the former, partly crossing it, therefore in the foregoing this will be referred to as “crossing dip range”. The “long-plain” is of brook character, rarely drying out completely, the other, the “crossing dip range” is preferably marshy. Their labelling in the Table is: “long-plain”=L-l, “Crossing dip range”=C-l. The bathing section of the backwater is labelled “B”.

The “cow-track” is made profitable by the regular grazing of cattle, and the precipitation washes in a large amount of dung matter from the grazing land, mainly into the dip of the “long-plain” (L-l). Accordingly, the water here is significantly eutrophic. Mostly only hogs rove the marshy dip (C-l). The bathing area of the backwater is becoming eutrophic gradually, first of all in the Summer period.

Water-chemical analysis manifested the monthly measured pH value of the water at the Alpár backwater to be mostly above 8,0, and the holiday resort’s water on the 15. 7. 1982 proved to be of Na-Mg type according to cation, and of CO_3 — HCO_3 type according to anion. All these show a slight degree of alkalization, in which the Mg-cation may also play role. The water-chemical data were provided by Mrs. KLÁRA FÜGEDI (Tisza-Research co-worker), to whom author should like to express his sincere thanks. The pH value of the waters at the “cow-track” region was found to be 8,0 or somewhat higher, and pH values of 9,0—9,5 were even measured at two points of the marshy dip. It seemed that the alkalization appears in patches, having mosaic heterogeneous character, as is customary to say: “vari-coloured”. There was also need for the chemical analysis of the waters and soil of the “cow-track” region at several points.

Materials and Methods

The taxonomic determination was carried out on living matter, therefore, when taking the bioseston-probes, at least one litre of water always remained unfixed, and one litre was fixed in formaldehyde for the purpose of quantitative studying. The drop method also applied earlier served for this (KISS 1982). As far as possible, a concentrate of 10 ml was prepared from every litre of the fixed water samples. After thorough shaking, one drop was taken with standard pipette for wet preparation (the volume being an average of 50 mm^3). The incidence of occurrence is shown in the Table using grades 1 to 5: 1=rare occurrence, 2=sporadic occurrence, 3=frequent occurrence, 4=very frequent occurrence, 5=mass production (algal bloom colouring the water). In the two biotops of the “cow-track” samplings were accomplished simultaneously on the following four occasions (Table 1): −1=16.3. 1982, −2=19. V. 1982, −3=1. 6. 1982, −4=25. 10. 1982. Water samples were taken from the bathing area of the backwater (B) on two occasions, shown on the Table as: −5=12. 6. 1982, −6=25. 10. 1982.

Physiological experiments were also carried out on the living bioseston substances of the *Euglena sanguinea* Ehr., and the *Microcystis aeruginosa* KÜTZ, as well as the *Aphanizomenon flos aquae* (L.) RALFS.

Results and Discussion

From the reviewed three biotops of the Alpár basin a total of 174 taxa could be determined in 1982. Their taxonomic distribution is as follows: Cyanophyta=30, Euglenophyta=47, Chrysophyta=45, Chlorophyta=52. It can be seen that the

Chlorophyta phylum leads in regard to taxon number, the Euglenophyta stands in the second place, the Chrysophyta in the third, and lagging behind, the Cyanophyta is in the fourth place. However, the image differs if the distribution is studied separately according to biotops.

L-l-biotop: Cyanophyta=15, Euglenophyta=45, Chrysophyta=37, Chlorophyta=45. Here the Euglenophyta and Chlorophyta taxon numbers are identical.

C-l biotop: Cyanophyta=20, Euglenophyta=24, Chrysophyta=36, Chlorophyta=12. In this case the Chlorophyta stands in the last place regarding taxon number, preceded twofolds by the Euglenophyta, and triply by the Chrysophyta, and even the taxon number of the Cyanophyta is higher.

B-biotop: Cyanophyta=21, Euglenophyta=36, Chrysophyta=37, Chlorophyta=49; according to which at the bathing section of the backwater, the Chlorophyta has prime role.

The total taxon number of the L-l biotop is 142, that of the C-l biotop is 92, and that of the B-biotop (bathing area) is 143. In general it is also noteworthy that two species of the Cyanophyta brought about algal bloom in all three biotops, and the Euglenophyta only in the L-l biotop of the "cow-track". Nevertheless, it established mass production with two species, colouring the water green. Furthermore, the *Phormidium pavlovskoense* ELENK. blue alga can also be mentioned, which is presumably a rare organism in our country.

During the course of the studies on the changes taking place in the algal associations of the three biotops, two main groups of factors influencing or determining the associations appeared, namely: the role of interactions between the algal species as well as the role of edaphic factors. From this point of view particularly the mass productions were rather striking, therefore these should be discussed first of all. The mass production of the two Cyanophyton species was greatly informative from the viewpoint of the interactions, and the algal bloom of *Euglena sanguinea* from that of the edaphic factors.

I. The algal bloom of the *Microcystis aeruginosa* and *Aphanizomenon flos aquae* in all three biotops (L-l, C-l, B) firstly raises the problem of the interaction between the algal species being present. The relating observations and experimental results of the author could be briefly reviewed as follows:

1. Both Cyanophyton species proved to have one-sidedly antagonistic effect in the association. That is: with their increase they inhibited the life functions of — or had direct destroying effect on — the other algal species in their environment, especially those belonging to other phyla. It was striking in case of all three biotops that in the period prior to the mass production of *Microcystis* and *Aphanizomenon,* many algal species belonging to other phyla were present in the association, from which, however, many species completely disappeared parallel with the increasing of the blue algae, and furthermore, even the relatively tolerant species were qualitatively pushed into the background.

2. The algal bloom of the *Microcystis* and *Aphanizomenon* developed in a particularly enormous degree in the deeper, less marshy and contiguous water surface parts of the C-l biotop, where the algal mass of the bloom covered the water surface with a greyish-blue, dense, 1—2 mm thick layer. Here the antagonistic effect was particularly striking: even from the Cyanophyton species only the *Lyngbya spiralis* occurred, which is frequent in alkalinized waters. The representatives of the Bacillariophyceae class seemed to be the most tolerant organisms, since here 11 species were detectabel. The Euglenophyta was represented by 7, the Chlorophyton by 4 species. Nevertheless, this relatively "high" number may also be attributable to the fact that

these Bacillariophyceae species are more likely manifested in the marshy areas. This was especially prominent in the cases of *Caloneis amphisbaena, Cymbella cystula, Gomphonema attenuatum* and *Navicula exigua.* The most characteristic was, however, that the blue algae forming the two mass productions showed less combination with each other; segregated from one another, they coloured the water at various areas.

3. In the Autumn of 1982 the *Anabaena affinis* proved to be a rather frequent organism in the L-l biotop. Among the trichomes aggregating at places, these parted into partially or completely detached planococcus-cells. The formation of such microcystoid-like planococcus agglomerations also covered by a thin gallert-envelope, was detected earlier by the author in the case of the *Spirulina platensis* and the *Anabaena spiroides* (KISS 1957, 1983).

4. The L-l biotop of the "cow-track" is divided into two sections by the path leading to the grazing land, but the two parts are connected by a stream. In the Autumn of 1982 the segregated mass productions of the *Euglena sanguinea* were found in the Northern region, and those of the *Aphanizomenon flos aquae* and the *Microcystis aeruginosa* in the Southern region. Despite the connection *Aphanizomenon* or *Microcystis* did not occur in the mass production of the *Euglena sanguinea,* and algae of other species were not observable either. On the other hand, the *Euglena sanguinea* was also entirely missing from the mass productions of the above-mentioned blue algae. Thus the antagonism seemed to be explicitly mutual.

5. Physiological experiments were also accomplished by the author to approach the essentials of this mutual antagonism. In every case the antagonism of the blue algae proved to be stronger. The individuals of *Euglena sanguinea* transferred to the living substances of the *Aphanizomenon* or the *Microcystis* suffered physiological damage within a few hours time. The metabic movement characteristic to the majority of the *Euglena* species ceased, the cells became more stocky, rarely taking a spheroid shape, by next day they became brown in patches and then completely disorganized. The *Aphanizomenon* or *Microcystis* transferred to the mass production of the *Euglena* species — depending on the transferred amount — likewise visibly damaged the cells of *Euglena sanguinea.*

6. Author had noticed centuries ago that with its onesidedly direct antagonism, the *Aphanizomenon flos aquae* var. *Klebahnii* ELENK. inhibited the mass production of the *Trachelomonas crebea* belonging to the Euglenophyta phylum, as well as the *Pteromonas angulosa* and *Eudorina elegans* ranked into the Chlorophyta phylum (KISS 1939). The mass production of *Eudorina elegans* was suppressed by the *Aphanizomenon flos aquae* in the Cibakháza bakcwater of the Tisza, too (KISS 1983a). The inhibitory factor may possibly be the selected material of the *Aphanizomenon* or the *Microcystis.*

II. Euglena algal bloom. The algal blooms of the *Euglena polymorpha* and the *Euglena sanguinea* are significant evidences for the fact that the precipitation washes many dung matter and stimulatory compounds into the water of the "cow-track" long dip range (L-l). The effect of these on the growing of Euglenophyton algal blooms was observed by author on many occasions from 1934—35 (KISS 1939, 1982), and it also encouraged him to carry out investigations in the present case. More earlier relevant data are known from polluted sea backwater, from Helsinki (VÄLIKANGAS 1922).

Other algae also occurred rarely or sporadically in the algal bloom of *Euglena polymorpha* developing in the Summer of 1982, however, the *Euglena sanguinea* established its mass production exclusively alone. (Author should like to express his sincere thanks here to DÁNIEL GÁL, Tisza-Research co-worker, for his help in sampling). The *Euglena sanguinea* not only coloured the shallow water rich in organic matter, but also cased over the surface of the reedy *(Phragmites)* marsh with a yellowish-green, 1—2 mm thick bioseston-layer.

It is characteristic that earlier the opinions were divergent concerning the edaphic environment of this organism. It was characterized by LEMMERMANN (1913) as follows: "Oligosaprob bis katharob". This opinion was also adopted by others. However, according to the great work of HUBER-Pestalozzi (1955) this organism forms intensively red algal bloom in the puddles containing a large amount of dissolved organic matter in the grazing lands of the Alps. Therefore, these biotops are called "Blutalgenseen" or "Blutseen" in these regions. According to author's observations, too, the *Euglena sanguinea* occurred in the alkalinized waters strongly polluted with organic matter (Lake Fehér at the border of Kardoskút, Dead-Körös at Kenderes-kert, Lake Bogárzó, Lake Ródliszék). On this occasion author has observed for the fifth time that it produces algal bloom in alkalinizating water, too. Nevertheless, he did not detect entirely red colouring in either of the occasions.

In connection with the algal bloom of this organism, HUBER-PESTALOZZI (1955) emphasized the role of weather in the following way: "Für das Auftreten und die Entwicklung der Wasserblüte von *E. sanguinea* sind bestimmte meteorologische Faktoren sehr wichtig (eigene Beobachtungen, KLAUSENER, HEIDT); am intensivten ist die Wasserblüte bei anhaltend warmen und klarem Wetter". Nevertheless, the permanent, hot fine weather means that of foehn-nature. Such weather condition in our lowland is the atmospheric subsidence front, or as otherwise called, the "free foehn", which may also have role in the fine weather conditions of Autumn. Weather of foehn-nature is the carrier of the so-called praefrontal physiological effects, which may also be active component in the life of algae. During the course of the last 50 years more than 100 Euglenophyta mass productions were analysed by us, and these were mostly produced in such conditions.

According to HEIDT (1934) the *Euglena sanguinea* loses its red colour on the effect of shading, the haematochrome granules congregate in the cell centre, and the cells change to green colour. This process takes place rapidly, within cc. 20 minutes. On the effect of light the cells change back to red colour in even shorter time. The cells of the *Euglena sanguinea* originating from the L-l biotop of the "cow-track" were mostly green in colour, nevertheless, in a frequency of 10—15% 3—4 dark red clod-like formations could be observed around the cell centres. On the effect of strong illumination these dark red clods disappeared within 2—3 hours and the cells became yellowish-green with slight pink shade. On the effect of darkening, after a few hours the haematochrome granules congregated into larger clods again.

In the collected bioseston author did not observe cell division in case of the *Euglena sanguinea,* therefore he also carried out culture experiments. From the brews of plant-seeds, again the brew of pea seeds *(Pisum sativum)* proved to be the best as nutrient solution, to which some raw lemon juice was also added. In 1935 — with the help of such ascorbic acid-enriched nutrient solution — the cells of *Trachelomonas crebea* not only divided rapidly, but the cells from its generations remained together abnormally, and four-celled pseudothalli developed in several cases (KISS 1939). In such nutrient solution the individuals of *Euglena sanguinea* divided by the following day, assuming spheroid shapes. No pseudothalli developed.

The *Euglena sanguinea* was also detected earlier in Hungary. SZABADOS (1936) made mention of it from 8 biotops, in two cases as the generator of algal bloom. It always occuerrd with a green colour. Mention was made of it from Lake Balaton and also from the Inner-Lake near Tihany. HORTOBÁGYI (1939) mentioned it as a

Table 1

No	Species — Taxon	L—1				C—1				B	
		–1	–2	–3	–4	–1	–2	–3	–4	5	6
	Phylum: Cyanophyta										
1.	*Microcystis aeruginosa* KÜTZING			1	5				5	5	
2.	*Coelosphaerium Kuetzingianum* NÄG.	2	3	2			2				2
3.	*Hydrococcus rivularis* (KÜTZ.) MENEGH.									3	3
4.	*Siphononema polonicum* GEITLER						2				6
5.	*Stigonema polonicum* GEITLER	2				2					2
6.	*Aphanizomenon fios aquae* (L.) RALFS		2	3	5				5	5	
7.	*Aphan. Issatschenkoi* (USS.) PROSK.—LAVR.		2								
8.	*Romeria elegans* (WOLOSZ.) KOCZW.	2	1	2			3	2			
9.	*R. gracilis* KOCZW.		2	1							2
10.	*R. leopoliensis* (RACIB.) KOCZW.	1	2	2						1	
11.	*Anabaena affnis* LEMM.		2		4		2				3
12.	*A. solitaria* KLEBAHN										3
13.	*Spirulina maior* KÜTZING	3				3					3
14.	*Sp. laxissima* G. S. WEST	2				2					
15.	*Oscillatoria brevis* (KÜTZ.) GOM.										4
16.	*O. limnetica* LEMM.					2					2
17.	*O. maior* VAUCHER	2									2
18.	*O. chalybea* (MERT.) GOM.						2			2	
19.	*O. lacustris* (KLEBAHN) GEITLER						3				
20.	*O. planctonica* WOLOSZ.						2			1	1
21.	*O. simplicissima* GOM.						4	2			
22.	*Phormidium luridum* (KÜTZ.) GOM.						3			2	2
23.	*Ph. mucicola* H. P. *et* NAUMANN										2
24.	*Ph. pavlovskoense* ELENKIN										3
25.	*Lyngbya aestuarii* (MERTENS) LIEBMANN		2			1	2				
26.	*L. Hyeronymusii* LEMM.										2
27.	*L. limnetica* LEMMERMANN		3	3		3					1
28.	*L. Martensiana* MENEGH.					2	2				
29.	*L. spiralis* GEITLER						1	2	2		
30.	*L. versicolor* (WARTM.) GOM.	2				2					
	Phylum: Euglenophyta										
31.	*Euglena acus* EHR.	2	3								3
32.	*E. caudata* var. *minor* DEFL	1		1							2
33.	*E. Ehrenbergii* KLEBS		2				2				
34.	*E. Klebsii* (LEMM.) MAINX	1	1		2			2			
35.	*E. oxyuris* SCHMARDA		2							2	3
36.	*E. polymorpha* DANG.		3	5							
37.	*E. proxima* DANG.	2			1		2				2
38.	*E. sanguinea* EHR.		1	1	5						
39.	*Lepocinclis acuminata* DEFL.		2								
40.	*L. constricta* MATV.										1
41.	*L. Lefevrei* CONRAD	2					2				2
42.	*L. ovum* (EHR.) LEMM.		3								3
43.	*L. ovum* var. *globula* (PERTY) LEMM.		1								2
44.	*L. ovum* var. *dimidio-minor* DEFL.		2								
45.	*L. teres f. parvula* CONRAD		1								2
46.	*Phacus acuminatus* STOKES	1	3	3	1	1	2	1	1	1	3
47.	*Ph. acuminatus* var. *indica* (POCHM.) H.P.	2	1				1				
48.	*Ph. acuminatus* var. *triquetra* SKVORT.		1			2					1
49.	*Ph. alatus* KLEBS	1			2					1	
50.	*Ph. caudatus* HÜBNER	3	3	3	1	1	1	1	1	2	1
51.	*Ph. helicoides* POCHMANN			1							3
52.	*Ph. onyx* POCHMANN									1	2
53.	*Ph. platalea* DREZ.	2									
54.	*Ph. pyrum* (EHR.) STEIN			3							3

No	Species — Taxon	L—1				C—1				B	
		−1	−2	−3	−4	−1	−2	−3	−4	−5	−6
55.	*Ph. suecicus* LEMM.	1		1							2
56.	*Ph. Wettsteinii* DREŻ.	2			2			3			
57.	*Trachelomonas crebea* KELL. em. DEFL.	1		2				1			3
58.	*Tr. Dybowskii* DREŻ.		3								2
59.	*Tr. granulata* SWIR.	2	2	1							1
60.	*Tr. granulosa* var. *crenulatocollis* (SZAB.) H. P.		2					2			
61.	*Tr. hispida* (PERTY) STEIN em. DEFL.	1		2	1	1			2		3
62.	*Tr. hispida* var. *coronata* LEMM.		3	1							2
63.	*Tr. hispida* var. *crenulatococllis* (MASK.) LEMM.	1	1				1				2
64.	*Tr. hispida* var. *crenulatocollis* f. *recta* DEFL.	2		2							1
65.	*Tr. intermedia* DANG.	2			1		1				2
66.	*Tr. lacustris* DREŻ.	1					3			1	1
67.	*Tr. Lefevrey* DEFL.		2		2						2
68.	*Tr. oblonga* var. *australica* PLAYF.		2	2					1		
69.	*Tr. planctonica* SWIR.	1	3	2		1				1	3
70.	*Tr. planctonica* var. *oblonga* DREZ.		2		1		1				2
71.	*Tr. scabra* PLAYF.	1	2	2	2	1	2	1	1	1	3
72.	*Tr. scabra* var. *coberensis* DEFLANDRE		3					2			2
73.	*Tr. scrabatula* (PLAYF.) DEFL.	1	1								2
74.	*Tr. silvatica* SWIR.	1	1	2				1			2
75.	*Tr. volvocina* EHR.	1	3	2	1	1	3	2	1	1	3
76.	*Strombomonas verrucosa* (DADAY) DEFLANDRE	2	3	1	1	1	1	1	1	1	3
77.	*Str. verrucosa* var. *zmiewika* (SWIR.) DEFL.	2	2	1			1				2
	Phylum: Chrysophyta										
78.	*Tribonema affne* G. S. WEST					3	2				
79.	*Tr. aequale* PASCHER					3	2				
80.	*Tr. vulgare* PASCHER					3	1				
81.	*Dinobryon divergens* IMH.									2	2
82.	*D. sertularia* EHR.									1	3
83.	*Anomoeoneis sphaerophora* (KÜTZ.) PFITZ.		1	1							
84.	*Achnanthes saxonica* KRASSKE						2	1	1		1
85.	*Asterionella formosa* HASS.	3	1								1
86.	*Caloneis amphisbaena* (BORY) CL.	2	3	1	1	1	1	1	2	3	2
87.	*Cyclotella operculata* (AG.) KÜTZ.		2		2				1		3
88.	*Cymbella cistula* (HEMP.) GRUN.		3		3				2		3
89.	*C. prostrata* (BERK.) CL.		3	2		1	2				
90.	*C. tumidula* GRUN.	3		1							
91.	*C. ventricosa* KÜTZ.	2	1	1		1					2
92.	*Fragilaria capucina* DESM.	2	1	2				2			2
93.	*Fr. crotonensis* KITT.	3	2	2			1	3			3
94.	*Fr. virescens* var. *capitata* OSTR.	3	1	1	2	1			2		3
95.	*Gomphonema augur* EHR.	2	1		1		1	2			3
96.	*Gyrosigma acuminatum* (KÜTZ.) RABENH.	3	3	2		2	1			2	
97.	*G. attenuatum* (KÜTZ.) RABENH.	1	1	1	1		2		3		2
98.	*Melosira granulata* var. *muzzanensis* (MEIST.) HUST.										2
99.	*M. varians* AGARDH										2
100.	*Navicula cincta* (EHR.) KÜTZ	2	1	1			2				3
101.	*N. cryptocephala* KÜTZ.	2	2		1	1		1			2
1C2.	*N. exigua* (GREG.) O. MÜLL.	1	1	1			2	2	2		3
103.	*N. gracilis* EHR.	1	1	3	1	2	1	1	1	1	1
104.	*N. graciloides* MAYER	2	1	2			2			2	
105.	*N. gregaria* DONK.		2	1		2		2			1
106.	*N. Heufleriana* (GRUN.) CL.	2		1	1		1				2
107.	*N. ventralis* KRASSKE	1	2			1			1	1	1
108.	*N. radiosa* KÜTZ.		2	1		2					1
109.	*Nitzschia acicularis* W. SM.	3	2	1		1		1	1		3
110.	*N. capitellata* HUST.	1	2		1	1		3			2

No	Species — Taxon	L—1				C—1				B	
		−1	−2	−3	−4	−1	−2	−3	−4	−5	−6
111.	*N. gracilis* HANTZSCH.	2	1	1		2	2				2
112.	*N. palea* (KÜTZ.) W. SM.	1	1		2			1			1
113.	*N. sigmoidea* (EHR.) W. SM.	2	2	3							
114.	*N. vermicularis* (KÜTZ.) GRUN.	3	1		2	1	1			2	
115.	*Synedra actinastroides* LEMM.	3	1		2	2	2				1
116.	*S. acus* KÜTZING	3	2	1			1				3
117.	*S. acus* var. *angustissima* GRUN.	2	1	2			1				1
118.	*S. affnis* KÜTZ.	3	1	3				1			1
119.	*S. tabulata* (AG.) KÜTZ.	1	2		2		3				3
120.	*S. ulna* (NITZSCH.) EHR.	1		1		2			1		2
121.	*S. ulna* var. *oxyrhynchus* (KÜTZ.) V. H.	1	1		1	1					1
122.	*Stauroneis anceps* EHR.		2	1							
	Phylum: Chlorophyta										
123.	*Chlamydomonas Reinhardi* DANG.										3
124.	*Pandorina morum* (MÜLLER) BORY										3
125.	*Actinastrum Hantzschii* LAGERH.	2	1	1							
126.	*Ankistrodesmus acicularis* (A. BR.) KORS.	2	2		1						1
127.	*A. angustus* BERN.	2	1								1
128.	*A. arcuatus* KORS.		2		2						2
129.	*A. falcatus* (CORDA) RALFS		3		2						2
130.	*A. spiralis* (TURN.) LEMM.										2
131.	*Coelastrum microporum* NÄG.	3	1	1	1					1	2
132.	*Coel. pseudomicroporum* KORS.	1	2							3	2
133.	*Coenocystis planctonica* KORS.	1									
134.	*Coen. reniformis* KORS.	1									
135.	*Crucigenia apiculata* (LEMM.) SCHMIDLE		2	3	1		1			2	1
136.	*Cr. rectangularis* (NÄG.) GAY.	2	1							1	1
137.	*Cr. quadrata* MORREN	1	3							2	
138.	*Cr. tetrapedia* (KIRCHN.) W. et G. S. WEST	1	3	2	1	3				3	3
139.	*Cr. truncata* G. M. SM.	1	1	3	1		2	2	1		2
140.	*Kirchneriella contorta* (SCHMIDLE) BOHL.		1	3	1					3	1
141.	*K. irregularis* (G. M. SM.) KORS.	1		2						1	1
142.	*K. obesa* (W. WEST) SCHMIDLE	1		2	1					3	2
143.	*Radiococcus spec. (? R. Wildemani* SCHMIDL.*)*										2
144.	*Pediastrum Boryanum* (TURP.) MENEGH.	3	3	2	2						2
145.	*P. Boryanum* var. *longicorne* REINSCH	1	1	1	1						1
146.	*P. duplex* MEYEN	2	3							1	
147.	*P. duplex* var. *rugulosum* RACIB.	1	1							1	
148.	*P. simplex* MEYEN	3	1	1	1						1
149.	*P. simplex* var. *radians* LEMM.	1	1								
150.	*P. tetras* (EHR.) RALFS		2								1
151.	*Scenedesmus acuminatus* (LAGERH.) CHOD.	2	3	3	3	1	2	1	1	3	3
152.	*Sc. acutus* MEYEN	2	3	1	1	1	1			2	3
153.	*Sc. arcuatus* LEMM.	1	1	1	3						2
154.	*Sc. bicaudatus* var. *brevicaudatus* HORTOB.	3	2	2	2						3
155.	*Sc. denticulatus* LAGERH.	2	2	1							1
156.	*Sc. ecornis* (RALFS) CHOD.	3	1	3	1					1	2
157.	*Sc. ecornis* var. *disciformis* CHODAT	2			2						1
158.	*Sc. intermedius* CHOD.	1	3	2	1					1	2
159.	*Sc. intermedius* var. *bicaudatus* HORTOB.				1					1	3
160.	*Sc. ovalternus* CHOD.	3	2	1	3		1				3
161.	*Sc. quadricauda* (TURP.) BRÉB	2	2	2	2	1		1		2	3
162.	*Sc. securiformis* PLAYF.	3	1	2	2		1			1	1
163.	*Sc. spinosus* CHODAT	2	1	1							3
164.	*Tetraedron minimum* var. *apiculatum* REINSCH	1	2								2
165.	*T. muticum* (A. BR.) HANSG.	1	3	1	1		2	1		2	3
166.	*T. proteiforme* (TURN.) BRUNNTH.	1	3	1						1	
167.	*T. trilobatum* (REINSCH) HANSG.		2	1					1	1	2

No	Species — Saxon	L—1				C—1				B	
		—1	—2	—3	—4	—1	—2	—3	—4	—5	—6
168.	*Tetrastrum staurogeniaeforme* (SCHRÖD.) LEMM.	1	1	2	3	1	1	2	1	2	1
169.	*Hormidiopsis spec.*									2	2
170.	*Cladophora fracta* KÜTZ. ampl. BRAND									4	3
171.	*Closterium aciculare* TUFFEN WEST		2							1	3
172.	*Cl. gracile* BRÉB.	1	3	1						2	1
173.	*Cl. dianae* EHR.		1		2						3
174.	*Mougeotia scalaris* HASS.									3	1

species occurring rarely — also with green colour — at the Nagyfa backwater of the river Tisza. SZABADOS (1936) writes the following about his culture experiments: "The *Euglena sanguinea*-s multiplied quickly in maize+Detmer+distilled watter+meat brew solution, moreover individuals exposed to temperature of +26—30°C also formed a low amount of haematochrome, which situated in the centre of the body in small patches, in groups". This experiment also proves that the representatives of the Euglenophyta phylum are capable of utilizing organic materials even in a direct manner. The problem of haematochrome formation and migration can only be settled by studies on pure cultures originating from individual cells.

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Algológiai vizsgálatok a Tisza-völgyi Alpári medence vizeiben

KISS I.

Tiszakutató Munkacsoport, Szeged

Kivonat

Az Alpári medence vizeinek algológiai vizsgálata 1982-ben tovább folytatódott. Az év során összesen 174 species vagy azon belüli taxon volt determinálható. A kialakult algatársulásokat befolyásoló környezetbiológiai tényezők főleg a négy alkalommal kialakult „vízvirágzás" során volt tanulmányozható. Különösen feltűnő volt az *Aphanizomenon flos-aquae* és a *Microcystis aeruginosa* kékalgák egyoldalúan antagonista hatása. Ezek tömegprodukciója minden biotópban előfordult. Az *Euglena sanguinea* és az *E. polymorpha* vízvirágzása ismételten bizonyította, hogy az Euglenophyton speciesek a szerves trágyával szennyeződött vizekben hozhatnak létre hatalmas tömegprodukciókat.

Élettani kísérleteink szerint az *Euglena sanguinea* sejtosztódását csekély aszkorbinsavval dúsított borsómagfőzetes táptalaj nagymértékben elősegítette. E szervezet zöld tömegprodukciójában az egyedek 10—15%-ánál a sejt közepe táján 3—4 sötétvörös hämatochrom rög volt észlelhető. Ezek megvilágításra 2—3 óra alatt eltűntek, sötétítésre ismét megjelentek. Szerző és mások e szervezet magyarországi előfordulását többször is észlelték.

Алгологические исследования в водах Алпарийского бассейна долины Тисы

И. Кишш

Рабочая группа по исследованию Тисы, Сегед

Резюме

Алгологическое исследование вод бассейна Алпари продолжалось дальше в 1982 году. За год было определено 174 вида или таксонов внутри видов. Биологические условия внешней среды, влияющие на сформировавшиеся сообщества водорослей, можно было исследовать главным образом в ходе четырёх случаев «цветения воды». Особенно отчётливо наблюдалось одностороннее антагонистическое влияние синих водорослей *Aphanizomenon flos-aquae, Microcystis aeruginosa.* Их вегетативная масса наблюдалась во всех биотопах. Вызванное *Euglena sanguinea* и *E. polymorpha* цветение воды ещё раз подтвердило, что виды *Euglenophyton* в загрязнённой органическим удобрением воде способны создавать огромную вегетативную массу.

Как показывают наши биологические исследования, клеточное деление *Euglena sanguinea* в значительной степени стимулируется на питательной почве, приготовленной из зерна гороха с добавлением небольшого количества аскорбиновой кислоты. У 10—15% особей этого организма в зелёной вегетативной массе посредине клетки наблюдалось 3—4 тёмнокрасных гематохромных комка. Под влиянием освещения в течение 2—3 часов они исчезали, а в темноте снова появлялись. Как автор, так и другие исследователи неоднократно наблюдали появление этого организма в Венгрии.

Algološka ispitivanja u vodama Alpár-kotline reke Tise

KISS I.

Istraživačka grupa r. Tise, Szeged

Abstrakt

U 1982. godini nastavljen je rad na algološkim istaživanjima u vodama Alpár kotline. Izvršena je determinacija 174 vrste odnosno taksona. Uticaj ekoloških faktora na obrazovanje zajednica algi praćen je prilikom „cvetanja vode" u četiri navrata. Izrazit je bio jednostrani antagonistički uticaj *Aphanizomenon flos-aquae* i mrkih algi *Microcystis aeruginosa.* Njihova masovna produkcija se javljala u svakom biotopu. „Cvetanje vode" prouzrokovano *Euglena sanguinea* i *E. polymorpha* ponovo je potvrdilo, da Euglenophyton mogu postići visoku organsku produkciju samo u vodama zagadjenim organskim djubrivima.

Naši pokusi su pokazali da deobu *Euglena sanguinea* u velikoj meri pospešuje podloga od buljona graška obogaćena izvesnom količinom askorbinske kiseline. U masovnoj produkciji kod 10—15% jedinki uočava se u sredini ćelije tri do četiri tamno crvene granulacije hematohroma, koje pri osvetljavanju u roku od 2—3 sata nestaju, a pri zamračivanju ponovo se pojavljuju. Autor i drugi istraživači su ovu pojavu u Madjarskoj viša puta registrovali.

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RESULTS OF THE PRELIMINARY INVESTIGATIONS ON THE ALGACOMMUNITIES IN THE BACKWATER OF THE TISZA AT ALPÁR

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(Received May 12, 1983)

Abstract

Authors briefly review the results of their studies carried out in the backwater between 1976 and 1980. With these studies, they determined the biological water quality of the backwater. At the same time, they also detected the seasonal changes characteristic to the zone, on the basis of the composition of the alga-communities. In the studied years the tendency of changes was similar, in some cases, however, the effect of the changes in weather (flood, milder Spring, and colder Winter, resp.) resulted slight shifts.

In 1982 authors started a more detailed study at the Alpár backwater, in the frame of which they invariably examined the phytoplankton composition to species level. For the demonstration of the seasonal changes regarding the algacommunities the Czekanowski similarity index was used. Authors also studied the phytoplankton diversity of the water area by applying the Shannon-index.

The chlorophyll-a and pheophytin-a concentrations were determined from the monthly taken samples. The state of aliment supply at the water area by determining the phosphorus forms was followed with attention. Eventually, authors performed the most essential chemical studies, confined to the oxygen circulation and ionic dynamism.

Introduction

The determination of the incursive biological water quality of the surface waters in Hungary can be traced back since 1974, when the practical book "Biological water qualification" written by Dr. LAJOS FELFÖLDY was published. Since then the hydrobiologists working in the various parts of the country carry on their activities with uniform methodics. Their results in this concern have been published since 1977 (VÍZKELETI—LENTI 1977, 1979; BARTALIS 1978, 1981; DOBLER—SCHMIDT 1979). The studies on the algal vegetation of the backwater became known from the paper of I. KISS published in 1978. Information could be gained about the temporal changes of the phytoplankton stands — also in rivers — from the works of SCHMIDT—VÖRÖS (1981), BARTALIS (1978), VÍZKELETY (1977), UHERKOVICH (1968, 1969, 1971), HORTOBÁGYI (1941, 1942), KISS (1979a), DOBLER—KOVÁCS (1982), KISS K.T. (1974), Hydrobiological studies (Publishing House of the Czechoslovakian Academy of Sciences, 1973). The seasonal changes of the backwater's phytoplankton stand have been illustrated on dendrogram with the cluster-analysis (UPGMA) method following the determination of the Czekanowski similarity index (1909), and diversity has been calculated (VÖRÖS—NÉMETH 1981, HAJDU, 1977, 1979). The anaerobic process taking place in the water area of the backwater is known from the works of FELFÖLDY (1981) and VÁMOS (1972).

Materials and Methods

The studies carried out from 1976 to 1980 at the Alpár backwater were suitable for the biological water qualification of the water area. The water samples required for the studies were taken monthly from 1976 even to this day, drawn from open water — 20 cm below the surface — at the border of the village Tiszaalpár, above the mouth of the channel at Alpár—Nyárlőrinc.

To determine the biological water quality the following studies were carried out:

1. measuring of the water's specific conductivity,
2. counting of total number of algae on membrane filter, and to species level, resp., on agar by dropping aliquot amounts,
3. determination of chlorophyll-a and pheophytin-a concentrations,
4. saprobiological analysis according to the method of Pantle-Buck.

The chemical studies were also accomplished on the basis of the guide-book "Biological water qualification" by Dr. Lajos Felföldy. The results obtained between the period 1976—1980 are summarized on Table 1.

Results

a) The inorganic chemical basis of the backwater's water area was measured by conductivity. The average values showed that in 1976—1977 and in 1980 the water area was alpha-oligohalobic, concentrated fresh water. On the effect of rushing in Tisza water in the years 1977 and 1979 dilution was experienced to such extent that in 1978 and 1979 the halobity changed to beta-oligohalobic, fresh water of medium quality.
b) To determine the planktonic trophity of the backwater measurements were made referring to the chlorophyll-a concentration and the number of algae in one litre of water was counted. Comparing these results the water area proved to be eutrophic, highly productive.
c) The degree of pollution was characterized by the annual averages constituted from the Pantle-Buck saprobity index. The studied area of the backwater proved to be b-mesosaprobe, somewhat polluted.

The 5-years studies were suitable for detecting seasonal changes on the basis of the total algal count, the composition of chlorophyll-a and the algal communities.

The tendency of changes was similar in the studied years, in some cases, however, the effect of changes in weather (flood, colder Spring, Winter) caused slighter shifts. The months of Winter and early Spring, resp., could be characterized by medium total algae number (1—3 mill. i/l) and low chlorophyll-a concentration (1—10 mg/m^3). The only exception was experienced in January, 1980, when from the water sample taken from under ice, 57 mill. individual numbers were counted per litre, and the chlorophyll-a concentration was found to be 95 mg/m^3. The thick ice-sheet without show blanket prevented the stirring up of the precipitate, thus besides favourable light conditions the algal community of high individual number could be established.

The dominancy of the Chrysophyceae class *(Ch. biporus* and *Ch. rufescens)* was more striking in January and February. Nevertheless, in January, 1977, several species of the *Synura uvella* and the *Mallomonas* genus; and in March, April of 1978 the *Dinobryon bavaricum* characterized the water area.

At Spring the species representing the Chrysophyceae class gradually became repressed and parallel to this the species and individual numbers of diatom increased. The proportion of diatom reached 70—80% in May, June. These samples can be characterized by the *N. acicularis, N. subtilis, St. hantzschii* and a few *Cyclotella* species. In March, 1979, the mass appearance of *Asterionella formosa* was also detectable (Schmidt, Vörös 1981).

Simultaneously with the dominancy of diatom the total algae number increased

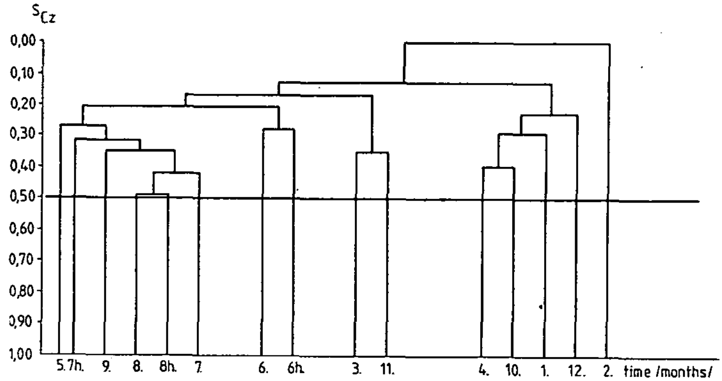

Fig. 1. Dendrogram of phytoplankton.

to 20—22 mill. i/l, and the chlorophyll-a concentration also surpassed the value of 20—30 mg/m^3.

The decrease in algal individual number in the early Summer months, and later the increase of these values by the beginning of Autumn — Autumn could be explained by the characteristic phytoplankton — macrophyta relationship characteristic to the backwater.

At the beginning of Summer the total algal count per litre ranged around 2—4 million, maximum 10 million i/l. Then 20 million were found again per litre by September—October. With the change in total algal number, there was also a change in the chlorophyll-a concentration. In the samples taken in the Summer months the proportion of green algae was higher, from which several species characterized the plankton by prominently high individual number. In whole, the Summer plankton association was in general characterized by balanced conditions, by the more uniform appearance of every alga group — counted by us.

In September—October the diatoms were those which were dominating again (*Melosira* gr., *St. hantzschii, Synedra acus, N. acicularis).*

In November—December the light conditions became unfavourable, the temperature decreased, therefore the decrease in number of algae was also a natural consequence. In this period, again the species of the Chrysophyta strain dominated in the water area.

In 1982, as one of the tasks of the Committee of Tisza Research, a more detailed study was started at the aforementioned water area of the Alpár backwater.

1. Accordingly, the phytoplankton composition was invariably studied (to species level), given in i/l.
2. The chlorophyll-a and pheophytin-a concentrations were determined from each sample.
3. The aliment supply was also followed with attention by determining the phosphorus forms.
4. Finally, the necessary chemical studies were also performed, presenting a basis for the hydrobiologist (oxygen circulation and ionic dynamism; Vízkeleti 1977, Kis K.T. 1974).

1. Following analysis of the alga-communities the Czekanowski similarity index was calculated (Czekanowski 1909). From the received index values, with the help of cluster analysis — using the average chain procedure (UPGMA) from the

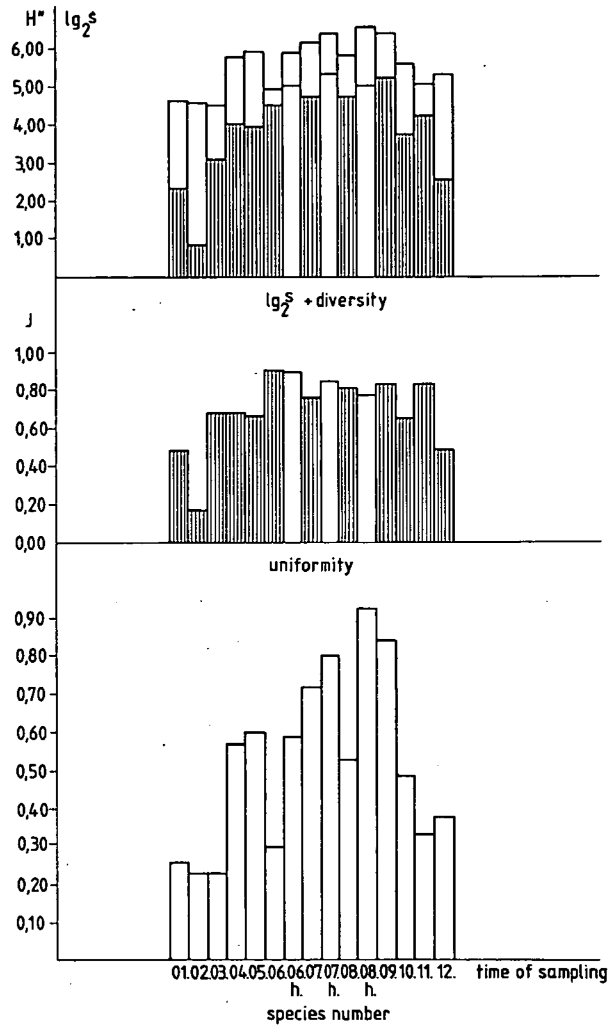

Fig. 2. Changes in time of the diversity (H") and uniformity of phytoplankton.

agglomerative hierarchy methods — dendrogram was prepared (Fig. 1). On the basis of the dendrogram the followings were established: the seasonal changes assumed so far became more concrete.

The linkages took place below the value of 0,50, for which the explanation could be given that the water area is not so balanced from the viewpoint of the alternation of the plankton communities. (Here we refer to flood, duck-pond, swimming, which by all means influence the long-lasting staying together of the alga-communities).

Four groups could be differentiated; which are the following three, since the 6—6h and the 3—11 are directly connected to each other, thus these can be comprehended as one core. Analysing further the dendrogram, besides the inherence of the 7.—8.—8h.—9th months, we can find the 6.—6h and 3.—11th months; and the 4.—10.—1—12th months appear as separate core.

The seasonal changes are detectable from the dendrogram, for the Summer months differentiate from the early Spring and late Autumn months, but the Spring — Autumn — Winter months form separate cores. It also becomes striking immediately that the algae association of the water sample taken in the second month, i.e. February, completely differs from that taken in the rest of the months of the year. This was caused by the fact that at that time the water area was dominated by a *Synura* species in an amount of 130 million, and this species did not manifest itself in such an i/l value neither earlier, nor later. Now we should like to examine which organisms are responsible for the associations and to what ratio?

In the 3—11th and 4—10th months the *Chrysococcus biporus* in 17,2% and 23,9%, resp., the *Cryptomonas erosa* in 17,8% and 4,4%, resp., the *Chroomonas acuta* in 17,8% and 5,4% were responsible for the associations (BARTALIS 1981). The ratio of the two latter organisms decreased with the rise in water temperature and the increase in the number of sunny hours. In the associations of the Summer months, the *Cyclotella glomerata, C. striata, Trachelomonas volvocinopsis* and *Ankistrodesmus angustus* played role in the first place, that is, those organisms which favour the balanced, warmer weather on the basis of the observations so far. *Chrysococcus* species dominated in the Winter samples, too. Months distinguished by the "h" letter are also observable on the dendrogram. This means that in that particular month, namely in the 6th, 7th and 8th, samples were also taken near reed-grass associa-

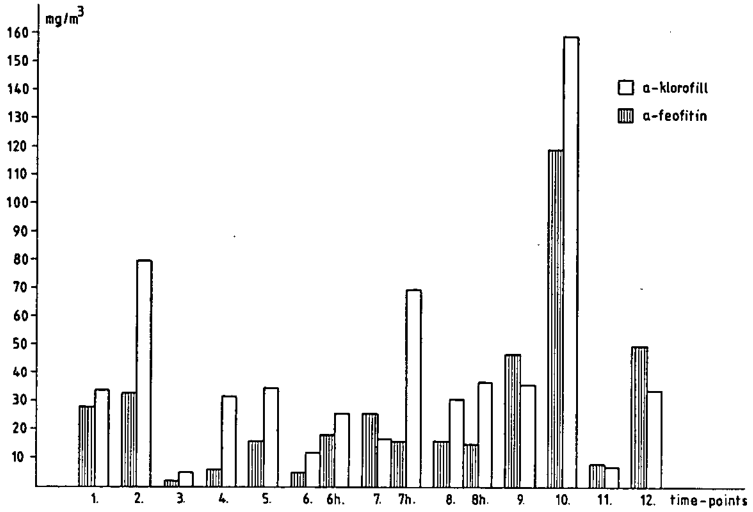

Fig. 3. Changes of chlorophyll-a and pheophytin-a concentrations.

ions. These water areas differed from the open water plankton associations of the otheronths dueothe *Cosmarium, Closterium, Staurastrum* and *Micrasterias*. species (VÍZKELETY 1979). Apart from the mentioned similarity index: values, the diversity was also studied, thus the variety of the plankton associations Diversity is the chaacteristic feature of biocenosis. During the course of our studies searched for an answer to the question, how does the species number and individual number change in the water, considering an optimal condition? It should be mentioned that the optimal condition can only be determined approximately, nev ertheless, the principle known in ecology is definitely of help (SEBESTYÉN 1963)-

I. the more varied the essential conditions of a biotop, the higher the species number of the biocenosis;
II. the more the essential conditions of a biotop shift from the normal and the optimum of most of the organisms, the poorer the biocenosis in species and the higher the appearance of individual numbers of the various members;
III. the more continuous the development of the millieu conditions of a habitation, the longer the period of similar environmental circumstances, the richer the biocenosis in species, the more settled and constant the biocenosis.

From the diversity indexes, we used the Shannon index, which gives the richness in species and the uniformity in a single number when characterizing the association (HAJDU 1977). Its "H" value varies between O, as minimum and lg_2s as maximum, and J between 0 and 1.

From the diversity diagram (Fig. 2) the differentiation of the February month mentioned at the discussion of the dendrograms is striking. In this month the growing space varied from the otpimum, thus the *Synura* increasing to 130 million i/l raised the number of individuals, but the species number decreased, therefore the values of diversity and the related uniformity are low. The values of diversity gradually increased by the end of the Summer months, which was also followed by the uniformity of the species, then there was a decrease and in December close to similar value to that found in January was observed, and at the same time the change in species number also followed this tendency. It should be mentioned of the samples taken from the reed-grass associations that in the studied period higher species number was found than in the open water, which was also proved by the value around 5 of the diversity indexes.

2. (Fig. 3). The chlorophyll-a measurings were carried out with routine nature, using them only as informational data, because rapid information was gained on the expectable algal number in the water area. Two maximums were measured from the open water, in February and in October. The highest total algal number counted in the year belonged to these values (130 million and 27 million i/l).

3. As already mentioned, the studies performed in 1982 also included the examination of the aliment supply at the water area. This was endeavoured to be followed by the determination of the phosphorus forms (Fig. 4). From January till April there was a gradual increase in the PO_4-P concentration of the water area, and with this also in the total phosphorus mg/m^3 amount. In May the available phosphorus suddenly decreased, due to the revival of the macrophytons. Till October the PO_4P amount of the samples taken from the open water and near the macrophytons remained unchanged, becoming stable around the concentration of 10 mg/m^3, therefore the macrophyton patches developing in the water area kept the available nutriment at low level. From July to October the majority of the concentration of the total phosphorus got into the water, thus it developed from the organic debris. During the course of the studies the determination of the sestonic inorganic phosphorus was also accomplished. The results proved that this phosphorus form has no significance in the viewpoint of aliment supply.

4. Finally, we should like to report on a few points of interest after reviewing the chemical studies.

As a test, the Ca^{++} ion mg/l concentrations of the yearly samples were also compared with cluster analysis (Fig. 5). Studying the dendrogram it becomes striking immediately that the 7—8—9th months belong together tightly, and in all three months, in the water type determined on the basis of the cation amounts, Na^+ and Mg^{++} ions occurred, therefore the Ca^{++} ionic source became exhausted in

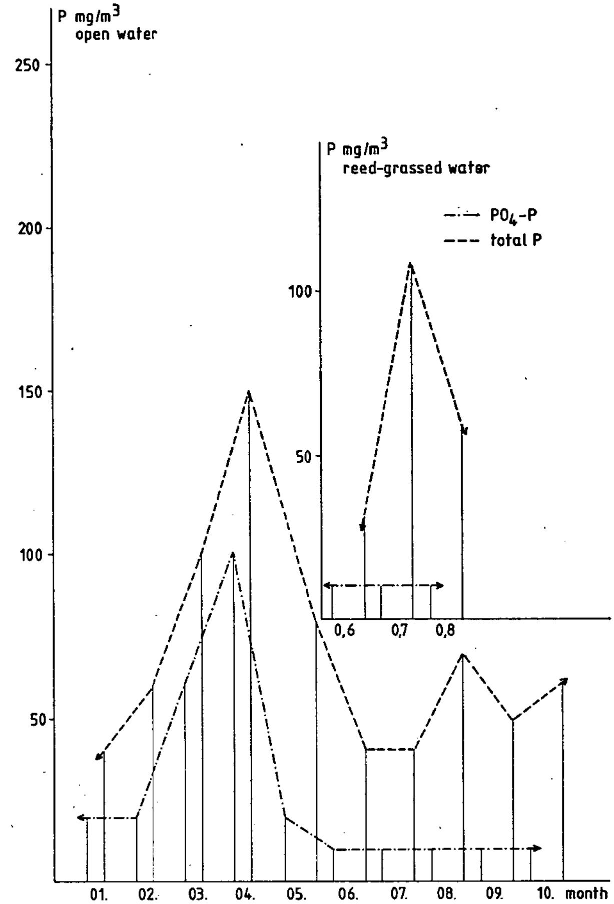

Fig. 4. Changes of phosphorus forms in open and reed-grassed water.

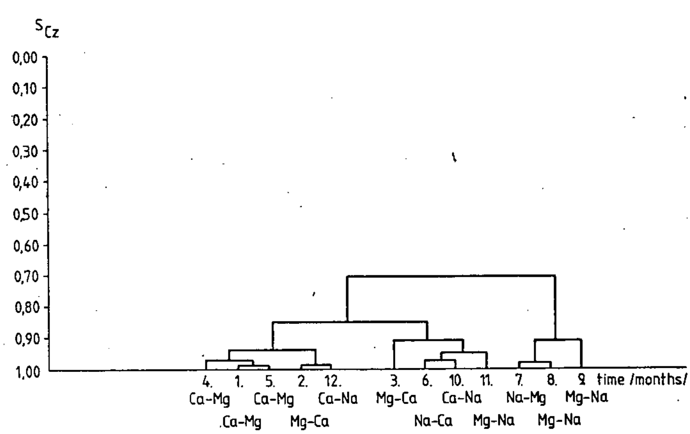

Fig. 5. Dendrogram of Ca^{++} ion.

these months. In the 7—8—9th months the temperature of the water was the highest and the temperature of the air also indicated canicular days (KISS, K. T. 1974). The followings could be reported on the oxygen household: the water's dissolved oxygen content decreased from the average 11,2 mg/l to 3,9 mg/l in August. This alteration was also accompanied by the decrease and increase, resp., of other components. Namely, by September, i.e. by the following month, the water's SO_4—ionic concentration decreased from the average 24,5 mg/l to 1,9 mg/l, at the same time, the highest dissolved iron mg/l value was measured. Reviewing the related literature, the following process took place: the dissolved oxygen minimum in August brought about anaerobic conditions in the deeper layer. This was proved by the sudden increase (0,28 mg/l) in the dissolved form of iron. Sulphate reduction was concluded from the sulphate ion decrease, which is not only due to the function of sulphate reductive bacteria, but also to the methane developing during the course of cellulose decomposition, and the reaction of sulphate ions. In this latter case $CaCO_3$ precipitation should be counted upon, therefore an explanation was found also to the minimal values of the Ca^{++} ions measured at that time (FELFÖLDY 1981).

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Az Alpári holtág algatársulásainak elővizsgálati eredményei

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Kivonat

A szerzők dolgozatukban röviden összefoglalják a holtágon 1976—1980 között végzett vizsgálataik eredményeit. Ezekkel a vizsgálatokkal megállapították a holtág biológiai vízminőségét. Ugyanakkor az algaegyüttesek összetétele alapján az égövre jellemző szezonális változásokat is megfigyelték. A változás tendenciája a vizsgált években hasonló volt, esetenként azonban az időjárás változásának hatása (árvíz, hűvösebb tavasz, illetve hidegebb tél) kisebb eltolódásokat eredményezett.

1982-ben részletesebb vizsgálatot kezdtek az Alpári holtágon, amelynek keretében változatlanul vizsgálták a fitoplankton összetételét, faji szintig. Az algaegyüttesek szezonális változásának bemutatásához a Czekanowski hasonlósági indexet használták. A szerzők vizsgálták még a víztér fitoplankton diverzitását is a Shannon-féle index felhasználásával.

A havi gyakorisággal vett mintákból meghatározták az a-klorofill és az a-feofitin koncentrációkat. Figyelemmel kísérték a víztér tápanyagellátottságát a foszfor formák meghatározásával. Végül elvégezték a legszükségesebb kémiai vizsgálatokat, amelyek az oxigénforgalom és az ion dinamizmusra korlátozódtak.

Результаты предварительных анализов сообществ водорослей в мёртвом русле Алпари

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Резюме

Авторы работы кратко обобщают результаты исследований, проведенных в мёртвом русле Алпари в 1976—1980 гг. На основе этих исследований было определено биологическое качество воды мёртвого русла. В то же время на основании состава сообществ водорослей наблюдались и характерные для данного климатического пояса сезонные изменения. Тенденция этих изменений в течение исследуемого периода была в общем подобна, однако в некоторых случаях под влиянием погодных изменений (наводнение, более холодная весна, или более суровая зима) наблюдались некоторые отклонения.

В 1982 году в воде мёртвого русла Алпари были начаты более подробные исследования, в ходе которых неизменно продолжали анализ состава фитопланктонов (на уровне видов). Для показа сезонных изменений в сообществах водорослей применяли сравнительный индекс Чекановского. Авторы исследовали также дивергенцию фитопланктонов с использованием индекса Шаннона.

В пробах, которые брались каждый месяц, определяли также концентрацию хлорофилла-а и феофитина-а. Велись наблюдения по определению степени обеспеченности воды питательными веществами с помощью определения форм фосфора. Наконец, были проведены также и наиболее необходимые химические анализы, которые ограничивались определением оборота кислорода и динамики ионов

Preliminarni razultati istraživanja algi u mrtvaji Alpár

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Abstrakt

Autori su sumirali razultate istraživanja za period 1976—1980. u odnosu na kvalitet vode mrtvaje. Pored zajednica algi pratili su i karakteristične sezonske promene za to podneblje. U ispitivanom periodu promene su bile ujednačene, mada su periodične promene vremenskih prilika (vodostaj, hladnije proleće, odnosno zima) rezultirale izvesnim odstupanjima.

Detaljnija istraživanja fitoplanktonskih zajednica do nivoa vrsta vršena su od 1982. godine. Analiza zajednica algi vršena je Čekanovskim indeksom sličnosti, dok je diverzitet odredjivan Shannon-ovim indeksom.

Mesečne probe su poslužile za odredjivanje koncentracije hlorofola- a i feofitina-a. Foforne forme su poslužule za odredjivanje sadržaja hranljivih materija. Takodje je izvršena i hemijska analiza u odnosu na promet kiseonika i dinamiku sadržaja jona.

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STUDIES ON THE QUALITATIVE AND QANTITATIVE COMPOSITION AND THE SEASONAL CHANGES OF PHYTOPLANKTON AT THREE SAMPLING AREAS OF THE DEAD TISZA AT LAKITELEK

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(Received May 12, 1983)

Abstract

The studies on phytoplankton were carried out at three sampling points of the dead Tisza a Lakitelek, in the Northern region being under nature conservancy. When processing the samples taken monthly over a period of one year, authors studied the qualitative and quantitative composition as well as the seasonal changes of phytoplankton. The biomass and diversity of phytoplankton were measured on the basis of the total algal count. With the help of cluster analysis authors searched for an answer to the question, what kind of similarities in time and space are manifested by the algal communities of the three sampling places? The changes in phytoplankton composition showed the differentiation of the three sampling places in Summer, following the uniformity of the water spaces in Spring. In the months of Autumn and Winter the samples taken from the 2nd and 3rd sampling places showed tight relationship and similar phytoplankton composition. The disconnected Northern region of the backwater was characterized throughout the whole year by plankton associations of differing compositions.

Introduction

The backwater at Lakitelek is a bend cut through during the course of the river control accomplished in the last century. It has still kept to this day its ancient state characteristic of backwaters along the river Tisza. The Northern section of the dead channel is a part of the Kiskunság National Park since 1975, standing under nature conservancy. Similar to our studies carried out between 1976—1980 at the Environment Protection Area at Mártély (DOBLER, KOVÁCS 1982, KISS 1982), our task is to estimate the present condition of the backwater, so that our results could be used for a basis of comparison when observing the harmful effects befalling the water space.

The estimation of the phytoplankton at the Lakitelek backwater of the Tisza was started by ISTVÁN KISS in the beginning of the 60s. Regular samplings (in every season) were started from 1975 (KISS 1978a, b). Comparing the phytoplankton associations of the Northern section under nature conservancy, with the Southern channel part not under protection author established that besides the exclusive occurrence of a few species, the difference between the two water spaces is manifested in the higher Euglenophyton species and individual number of the Southern section. UHERKOVICH (1971) performed phytoplankton studies of informative nature at the Tisza backwater of Lakitelek at the end of March, 1968. Apart from the high dominancy of *Synura uvella* EHR. and *Cyclotella* sp. in Spring, he determined that the backwater's flowering plants and algal vegetation give evidence of a higher level of limnological individualization.

The nearby, similar geological and limnological backwaters show many related features to the qualitative and quantitative composition of the phytoplankton at the backwater of Lakitelek (Kiss 1979, Dobler, Kovács 1984).

The phytoplankton studies at the Tisza backwater of Lakitelek were carried out according to the following viewpoints:

1. The composition, seasonal changes of the algal communities characteristic to the backwater, at the three sampling places.
2. Studies on the similarities in time and space between the various sampling areas.

Materials and Methods

Samples were taken between May 1982 and April 1983 throughout a year, monthly, from the middle of the water area by way of dipping about 20 cm below the surface.

a) Total algal count was determined from the samples.
b) The biomass of phytoplankton was counted (Bartha 1977, Dussart 1966, Nauwerck 1963, Sebestyén 1954, Tamás 1955, Willen 1961).
c) The Shannon species-individual number diversity values were calculated (Shannon—Weaver 1963).
d) The similarities of the samples originating from the different sampling places and taken at various intervals were measured by the Czekanowski (1909) similarity index. On the basis of the resulted similarity matrixes cluster analysis was performed using the average chain (UPGMA) method from the agglomerative, hierarchy methods (Sneath-sokal 1973). It was investigated, which species are responsible, and in what ratio for the association of the most inner sample pairs of the similarity dendrogram (Hajdú—Rajczy 1981).

Discussion of results

1. Characterisation of sampling areas, qualitative and quantitative composition as well as seasonal changes of the phytoplankton.

a) The No. 1. sampling place can be found in the shallow, marshy Northern end of the backwater (Fig. 1). It is characterized by water depth of maximum lm and thick precipitate containing black ferric sulphide. By the end of May the macrovegetative covering reaches 50%. Between the mosaics of *Nymphea alba* L.,

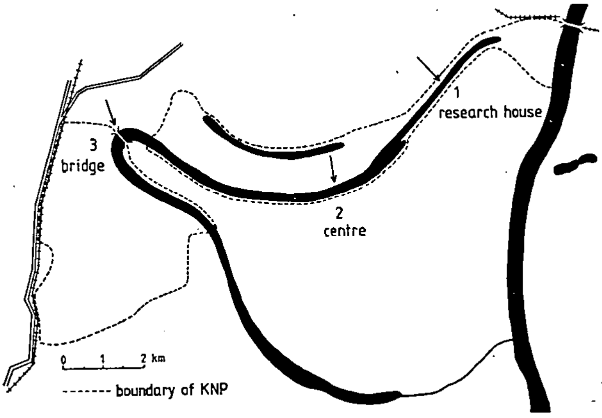

Fig. 1. Localization of the sampling areas at the dead Tisza at Lakitelek.

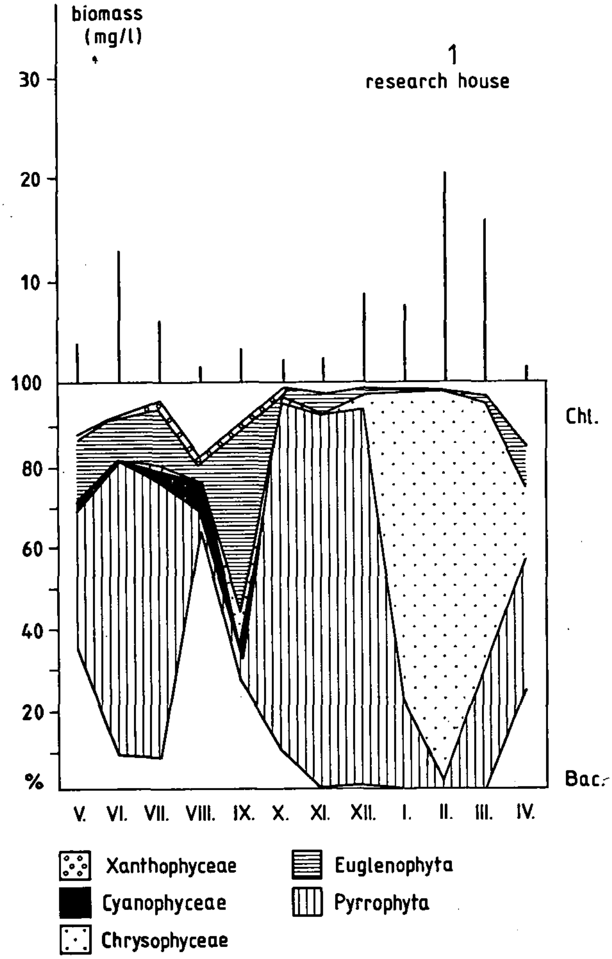

Fig. 2. Changes in the values of the phytoplankton biomass and the percental distribution of the biomass at the No. 1. sampling area (1982. V.—1983. IV).

Nuphar lutea (L.) SM., *Trapa natans* L. and the mesh of various types of reed-grass, opened water surface can only be found in the middle of the channel. It is segregated from the No. 2. sampling area by thick bulrush. The Northern end of the backwater is a disconnected channel section in the state of natural alluvium. The biomass values of the phytoplankton stand from the No. 1. sampling place are shown on Figure 2, below which the quota of the systemic groups can be seen, regarding the prevailing biomass as 100%. From the two biomass maximums that of June can be explained by the Pyrrophyta and Euglenophyta groups' large algae (*Trachelomonas volvocinopsis* SWIR., *Chroomonas acuta* UTERMÖHL, *Cryptomonas erosa* EHR.) and that of February by the mass appearance of Synura uvella Ehr. With the late Autumn devastation of the macrovegetation the shade effect and aliment competition cease, making possible the growth of the phytoplankton biomass.

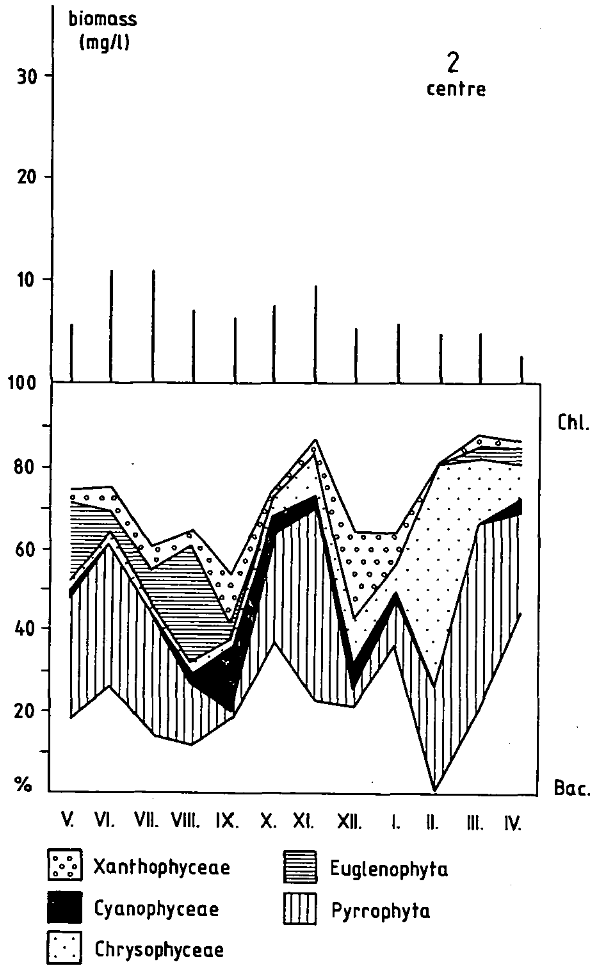

Fig. 3. Changes in the values of the phytoplankton biomass and the percental distribution of the biomass at the No. 2. sampling area (1982. V.—1983. IV).

b. At the No. 2. sampling place (Fig. 1) the maximal watar depth is 2 m. The macrovegetation of similar composition as the afore-mentioned is stricted to the narrow riverside zone. According to our experiences this sampling area represents well the natural conditions of the backwater. The results of our studies carried out at this area are summarized in Fig. 3. This water area is characterized by the whole-year uniformity of the phytoplankton biomass, with slight decrease in Winter. At Spring the biomass of Euglenophyta and Pyrrophyta groups is significant and by the end of Summer a larger amount of blue algal stand also develops. In the Autumn and Spring algal associations the biomass of the species belonging to the Pyrrophyta and Chrysophyta groups prevails (*Cryptomonas erosa* EHR., *Cryptomonas ovata* EHR., *Chroomonas acuta* UTERMÖHL, *Chromulina* sp., *Chrysococcus biporus* SKUJA). Regarding the diatoms in Spring and Winter the stand of *Stephanodiscus tenuis* HUST. is significant, the Summer and early Autumn months

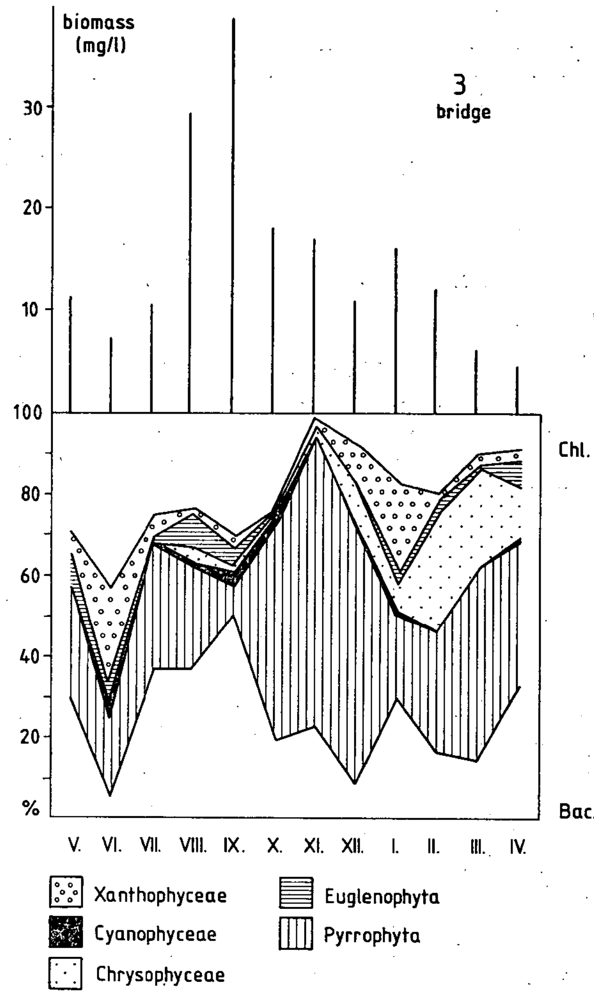

Fig. 4. Changes in the values of the phytoplankton biomass and the percental distribution of the biomass at the No. 3. sampling area (1982. V.—1983. IV).

are characterized by the large individual number of the *Stephanodiscus dubius* (FRICKE) HUST.

c) The No. 3. sampling place is situated at the bridge of Tőserdő (Fig. 1). It is characterized by a maximal water depth of 3 m and flowering water-plant associations with composition similar to that described at the other two sampling areas. These associations are also limited to the riverside zone. This area of the backwater is exposed to strong anthropogenic effects (bathing, rod-fishing, agricultural tilling). At this sampling place the development of the maximum at the end of Summer was registered (Fig. 4). The biomass of the green algae and diatoms was found to be strickingly large in this period. Apart from, the Pyrrophyta group characterizing the Autumn and Winter months, the proportion of the Chrysophyta strain also increased from January. The maximums of the diatoms having similar composition to those of the No. 2. sampling area developed in Spring, Summer and Winter.

At all three sampling areas the highest values of diversity were experienced in the Summer months, indicating that the algal population maximums developing in Summer refer to the balanced phytoplankton associations of high diversity. The diversity index values decreasing in the Winter months at the time of the Winter biomass maximums are due to the outstandingly high individual number of a few species.

2. Similarities in time and space of the phytoplankton associations.

The values of the total algal number originating from every sampling area and time-point (a total of 36 samples) were used to calculate the similarities of the sample pairs. The percental values of the species responsible for the relatedness of the inner sample pairs of the groups are demonstrated beneath the dendrogram gained as the result (Fig. 5). At the No. 2. and 3. sampling areas our samples taken between May and October form a differentiating group. The fact that the samples taken at the same sampling area, but in different Summer months are more similar to each other than the algal associations originating from the same time-point, but from various sampling areas, refers to the variation of small degree of the two living places, developing in Summer. Few, but high individual numbered species are responsible for the tight relationship of the Summer samples taken from the No. 3. sampling area exposed to anthropogenic effects. It was found when analysing the sample pairs of the second group that many species — first of all green algae — contribute with low percental ratio to the increase in the value of the similarity index.

The linkage within group and the differentiation of the group related to the samples taken at the No. 2 and 3. sampling places in December and January are caused by the mass appearance of the *Asterogloea gelatinosa* PASCHER alga. The presence of small individual number of this species was also registered in the earlier years, nevertheless, the development of the population maximum (76,8 million, ind/l) was probably due to the mild Winter. On the basis of the experiences obtained in previous years the most characteristic species of the Winter algal associations at the Lakitelek backwater is the *Synura uvella* EHR., the individual number of which was minimal in the Winter of 1982.

The development of differentiating Summer and Winter algal associations is preceded by the development of phytoplankton associations of transitional composition, which can be characterized by lower total algal count and biomass values. The striking similarity observed at the No. 2. and 3. sampling areas in November and March is firstly caused by the *Asterogloea gelatinosa* PASCHER, and besides this species, the *Chrysococcus biporus* SKUJA as well as the *Chromulina* sp. species are those which contribute to the general similarity of the Autumn and Spring samples.

The IV/3, IV/2 and IV/1 groups indicate that the phytoplankton composition of the complete water area of the backwater is the most homogeneous in Spring. This conclusion is supported by the fact that the samples of the water area in front of the research house are only linked to the samples of the other two sampling places in these months.

Contrary to the Summer months, in the Autumn, Winter and Spring periods the samples originating from the various areas do not show expressed differentiation, the time-point of sampling is determinant in the development of the groups.

By the beginning of June the macrovegetation at the No. 1. sampling place reaches complete development. The aliment competition, the oxygen-deficient periods

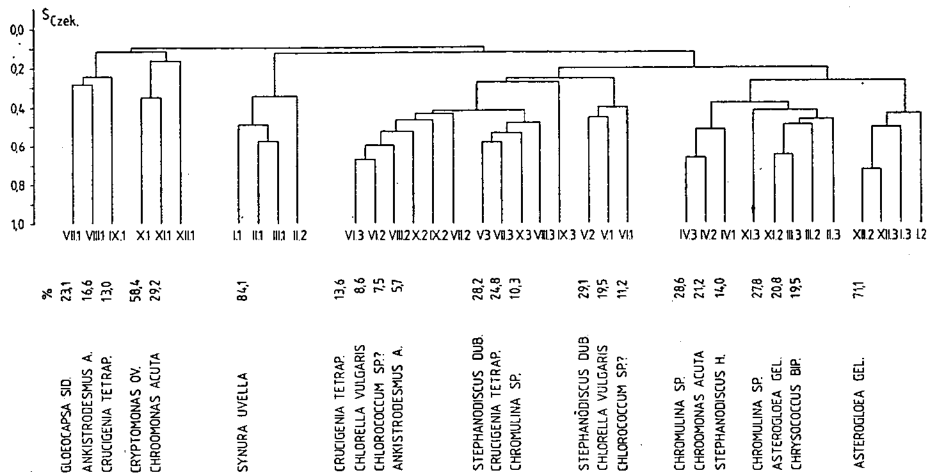

Fig. 5. Dendrogram of the phytoplankton samples (1982. V.—1983. IV).

during the night and furthermore, the shadiness depress the total algal number per litre as well as the value of the diversity index, establishing algal associations having compositions entirely different from the earlier ones. As a result, the Summer, Autumn and Winter groups of the sampling area are completely differentiated. The tight linkage of the Winter samples taken at the research house is determined by the mass occurrence of the *Synura uvella* EHR. and the *Chrysococcus biporus* SKUJA. The light microscopic pictures of the algae characteristic to the backwater are summarized in Tables I and II.

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A fitoplankton minőségi és mennyiségi összetételének, szezonális változásának vizsgálata a Lakiteleki holt-Tisza három mintavételi pontján

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Kivonat

Fitoplankton vizsgálatainkat a Lakiteleki holt-Tisza természetvédelem alatt álló északi részének három mintavételi pontján végeztük. Az egy éven át havonta vett minták feldolgozásakor vizsgáltuk a fitoplankton minőségi és mennyiségi összetételét, szezonális változását. Az összes algaszám alapján számoltuk a fitoplankton biomasszáját és a diverzitást. Cluster analízis segítségével kerestünk választ arra a kérdésre, hogy a három mintavételi hely algatársulásai térben és időben milyen hasonlóságot mutatnak. A fitoplankton összetételének változása a vízterek tavaszi egyöntetűvé válása után nyáron a három mintavételi hely elkülönülését mutatta. Az őszi és téli hónapokban a 2. és 3. számú mintavételi helyen vett minták kapcsolata szoros, fitoplankton összetétele hasonló. A holtág lefűződő északi részét egész évben eltérő összetételű plankton együttesek jellemezték.

Table I

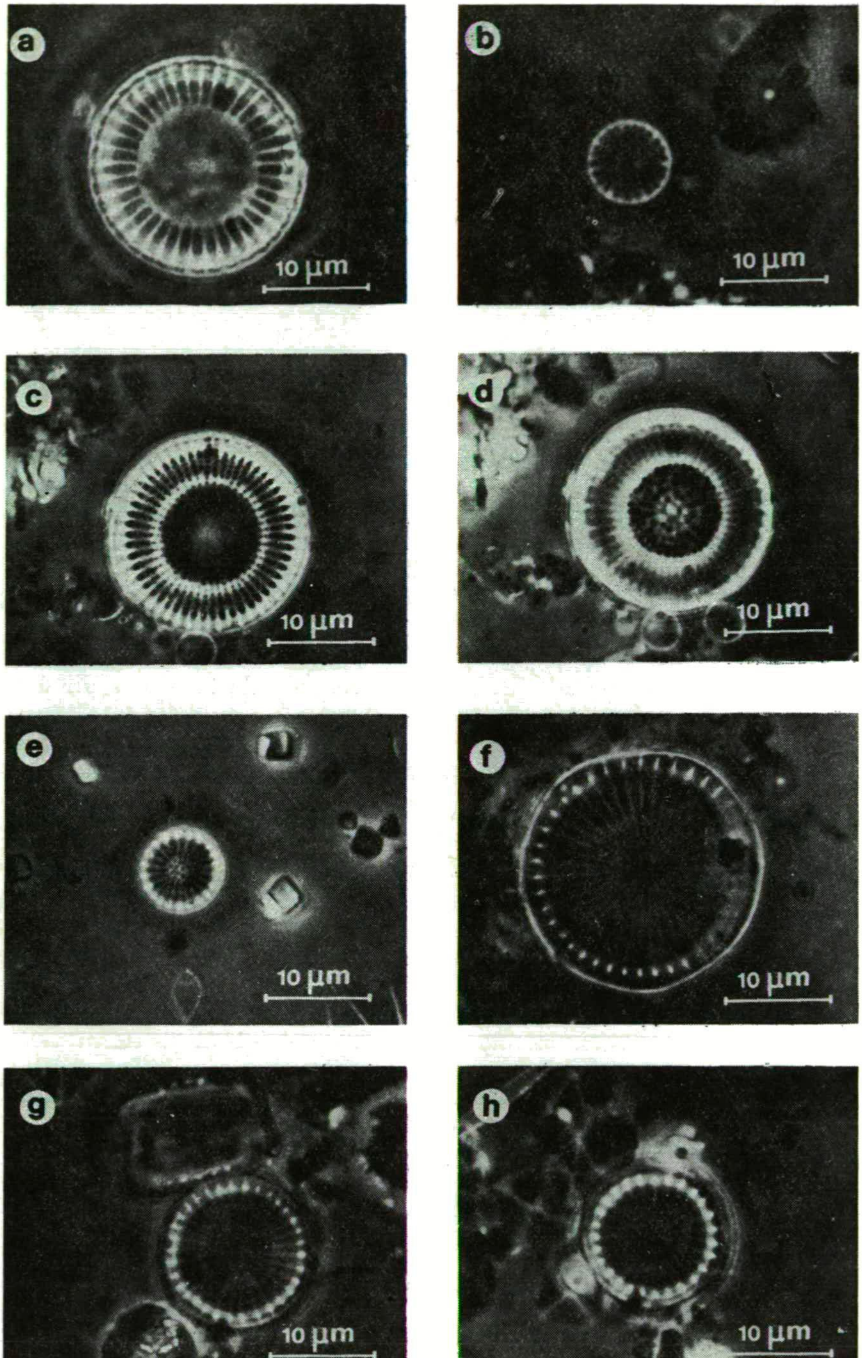
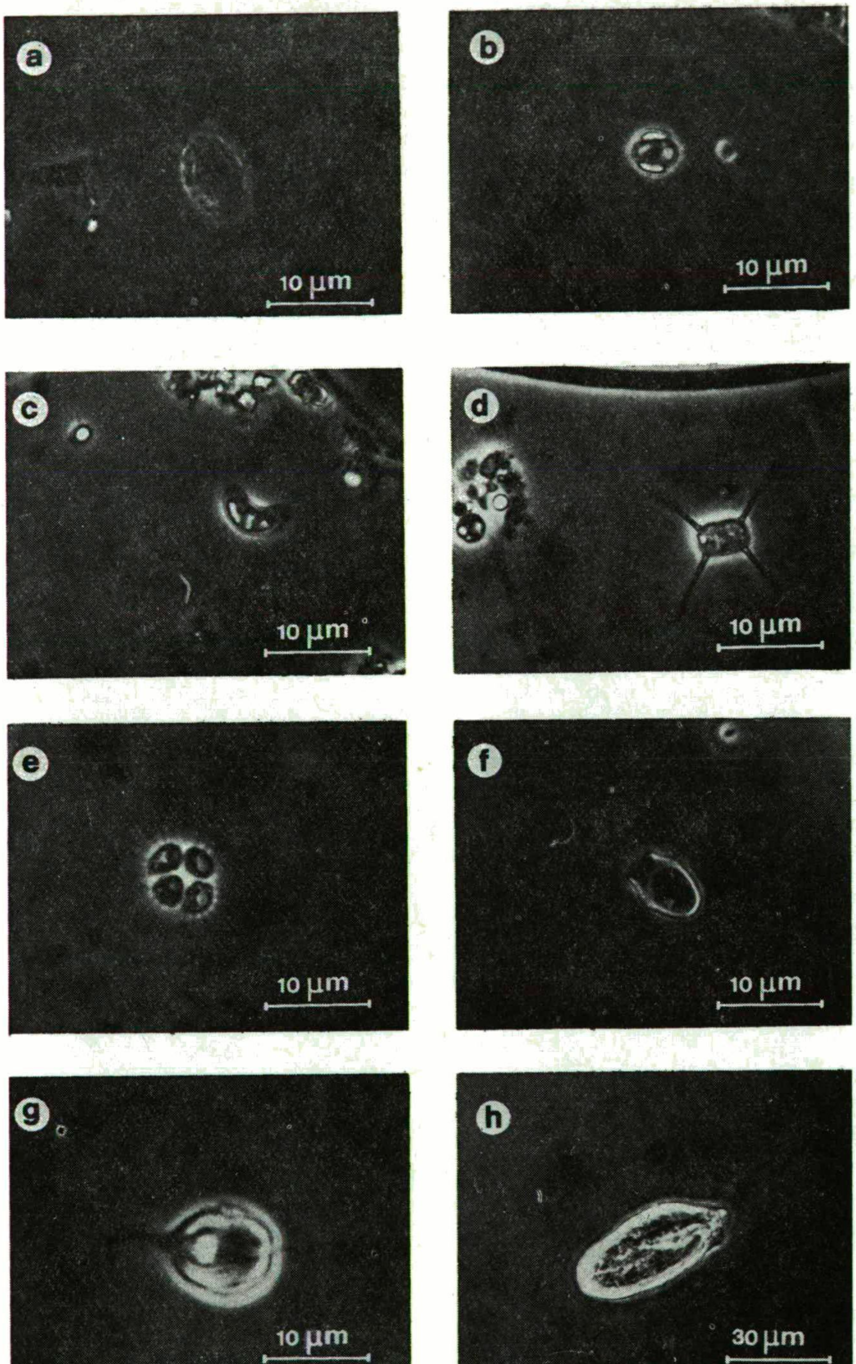


Table I and II: Microphotography by Dénes Budai.

Table II



Исследование количественного и качественного состава и сезонных изменений фитопланктонов в трёх местах взятия пробы в мёртвом русле Тисы Лакителек

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Резюме

Исследования фитопланктонов мы проводили в трёх местах взятия проб в северной части мёртвого русла Тисы в районе Лакителек, объявленной заповедником. В течение года ежемесячно брали пробы, в ходе обработки которых исследовали количественный и качественный состав, а также сезонные изменения фитопланктонов. На основе общего числа водорослей подсчитывали биологическую массу фитопланктонов и дивергенцию. С помощью Кластер-анализа пытались найти ответ на вопрос о том, какое подобие в пространстве и во времени наблюдается в сообществе водорослей в трёх местах взятия проб. Изменение состава фитопланктонов летом после весеннего слияния вод показывает разграничение трёх мест взятия проб. Между пробами, взятыми в осенние и зимние месяцы во втором и третьем местах взятия проб, наблюдается тесная связь, состав фитопланктонов здесь подобен. Отделяющуюся от мёртвого русла северную часть в течение всего года характеризуют сообщества планктонов другого состава.

Kvalitativna i kvantitativna ispitivanja fitoplanktona na tri punkta u mrtvaji Tise kod Lakitelek-a u sezonskom aspektu

Kovács Katalin i Dobler Lászlóné

Vodoprivredna uprava, Szeged

Abstrakt

Ispitivanja su vršena na tri punkta severnog dela zaštićene mrtvaje Tise kod Lakitelek-a. Mesečne probe u toku godine poslužile su za utvrdjivanje kvalitativnog i kvantitativnog sastava fitoplanktone i njegove sezonske promene. Biomasa i diverzitet dobiveni su na osnovu ukupnog broja algi. Clusterovom analizom dobiven je odgovor na pitanje kakva je prostorna i vremenska sličnost zajednice algi na tri istraživane punkta. Nakon proletnje ujednaćenosti, u toku leta javlja se razlika u sastavu fitoplanktona izmedju istraživanih punktova. U toku jeseni i zime fitoplankton na istraživanim punktovima br. 2 i 3 pokazuje veliku sličnost. Ha severnom delu mrtvaje planktonska zajednica se tokom cele godine karakteriše različitim sastavom.

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ZUSAMMENSETZUNG UND DYNAMIK DES ZOOPLANKTONS UND DER BODENFAUNA DES UNTEREN THEISSLAUFS

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Zusammenfassung

Im Zeitraum von 1978—1979 wurde die Zusammensetzung des Zooplanktons und der Bodenfauna auf 3 Profilen (A, B, C) des unteren Theisslaufs untersucht. An der Zooplanktonzusammensetzung nahmen teil: Protozoa, Rotatoria, Cladocera und Copepoda. Es wurden insgesamt 68 Taxa festgestellt, davon 12 Protozoa, 39 Rotatoria, 7 Cladocera und 10 Copepoda. Die Artenzahl variierte in der Abhängigkeit von Profil, Saison und von dem Jahr. Die höchste Zahl war auf dem Profil C vorhanden (54), dann auf dem Profil A (48) und auf C (31). Die höchste Zooplanktonentwicklung wurde in der Sommer, oder in der Herbstzeit festgestellt. Die Zahlwerte aus dem Jahr 1978 waren höher als die Werte im Jahre 1979.

Die Bodenfauna wurde durch die Oligochaeten und Chironomiden vertreten. Oligochaeten waren dominierend. Es wurden 11 Arten festgestellt. Mit der Ausnahme auf dem Profil B, wurden in der Bodenfauna auch die höheren werte im Jahre 1978 verzeichnet. Die Verbundenheit der Arten *Limnodrilus hoffmeisteri* und *Tubifex tubifex* in der ufernahen Region in manchen Zeitperioden weist auf eine stärkere organische Verunreinigung hin.

Einleitung

Die Theiss fliesst durch die Sozialistische Autonome Provinz Vojvodina auf einer Länge von 160 km und stellt ihr Unterlauf dar. Der Fluss hat ein kleines Gefäll und meandert mächtig (BUKUROV 1948). In manchen Zeitperioden, vor allem im Frühjahr und im Sommer, seltener aber im Winter, kommen oft hohe Wasserstände vor und die Tjeiss überschwemmt das umliegende Gelände. Auf dieser Gegend münden in der Theiss zuflüsse Karasch, Tschik. Jegritschka, Begej und Zlatica. Der Fluss ist auch mit dem Hydrosystem Donau—Theiss—Donau verbunden. Der Flussgrund ist alluvialer und diluvialer Ton.

Der antropogene Einfluss auf die Theiss ist sehr gross, sowohl durch die bestimmten hydrotechnischen Eingriffe (der Sperrmauerausbau) als auch durch die Verunreinigung mit den gewerblichen und kommunalen Abwässern. Davon ausgehend war das Ziel dieser Forschungen die Zusammensetzung und die Dynamik des Zooplanktons und der Bodenfauna zu untersuchen und zwar in Hinsicht auf die ökologischen und damit auch auf die anthropologischen Faktoren.

Übersicht der bisherigen Forschungen

Die Untersuchungen dieses Wasserlaufes werden schon seit mehreren Jahren durchgeführt. In der Ungarischen Volksrepublik sind diese Erforschungen komplexer und umfassen die phylikalisch-chemischen sowie biologischen Eigenschaften, dazu auch die Zusammensetzung der Biocönosen (MEGYERI 1957, VÉGVÁRI 1976, B. TÓTH MÁRIA 1976, HAMAR et *al.* 1976, und andere). An jugoslawischen Theissabschnitt eine gewisse Forschungszahl wurde nur vom Aspekt der sanitären Bedingungen aus (STANOJEVIĆ MILA, PUJIN VLASTA, 1973, STANOJEVIĆ MILA, 1978) durcheführt. Andere stellten gewisse Beiträge zur faunustischen Untersuchungen dar (DJUKIĆ NADA, 1979, PUJIN VLASTA, RAJKOVIĆ DRAGANA, 1979, RATAJAC RUZIĆA, 1979).

Arbeitsmaterial und Methoden

Die Untersuchungen wurden auf 3 Profilen (A., B., C.) durchgeführt. Es wurden die standarden Methoden angewandt- für die qualitative Zusammensetzung des Zooplanktons wurden die Proben mittels Planktonnetz Nr. 22 eingesammelt. Zur quantitativen Analysen wurden die Filtrations- und Sedimentationsmethode angewandt. Die Bodenfauna wurde mit dem Eckman-Birge Greifer gesammelt. Die Angriffsfläche betrug 225 cm^2. Diese Proben wurden nur in ufernahen Regionen genommen. Die Untersuchungen wurden im Laufe der 1978 und 1979 Jahre vorgenommen, in den Saisonintervalen.

Einige physikalisch-chemische Eigenschaften des Wassers im Untersuchungszeitraum

Die Jahresmittelwerte der Wassertemperatur liegen zwischen 12°—13,5 °C, die niedrigsten 1 °C, die höchsten 25 °C. Das Sauerstoffregime ist ziemlich günstig. Die mittleren Sättigungswerte batragen von 77% bis 84%. pH-Werte liegen von 7,7 bis 8,5. Für diesen Fluss sind die hohen Werte der suspendierten Stoffen kennzeichnend (STANOJEVIĆ MILA, PUJIN VLASTA 1973). Das Ahnliche hat auch VÉGVÁRI (1976) für den Mittellauf festgestellt. Ein ziemlich hoher Eiseninhalt ist auch charakteristisch. Aus diesen einigen, für die lebenden Wesen wichtigen Parametern ist zu ersehen, dass die Bedingungen des Sauerstoffregimes, des pH-Wertes und der Temperatur zufriedenstellend sind. Unter den bestimmten Bedingungen können zuviele suspendierte Stoffe und zu hoher Eiseninhalt einen nachteiligen Einfluss ausüben.

Die Untersuchungsergebnisse und Diskussion

In der qualitativen Zooplanktonzusammensetzung waren die folgenden Gruppen vertreten: Protozoa, Rotatoria, Cladocera und Copepoda. Da das Material vorwiegend im fixierten Zustand bearbeitet wurde, ist die Liste der festgestellten Protozoen nicht vollständig. Die qualitative Zusammensetzung des Zooplanktons ist in der Tabelle 1. dargestellt.

In der erwähnten Zeitperiode wurden 68 Arten festgestellt, davon 12 Protozoa, 39 Rotatoria, 7 Cladocera und 10 Copepoda. Die verschiedenartigste Gruppe bilden Rotatoria, was auch der Fall in den anderen Flüssen Vojvodinas ist. Es treten nicht alle Arten auf allen Profilen auf. So wurden auf dem Profil A insgesamt 48 Arten festgestellt (11 Protozoa, 25 Rotatoria, 3 Cladocera und 9 Copepoda), auf dem Profil B nur 31 (7 Protozoa, 15 Rotatoria, 3 Cladocera und 6 Copepoda). Die meisten Arten wurden auf dem Profil C (54) festgestellt (11 Protozoa, 30 Rotatoria, 6 Cladocera und 7 Copepoda). Eine so verschiedenartige qualitative Zusammensetzung weist auf die unterschiedliche Bedingungen auf einzelnen Sektoren hin. Im Vergleich zu den Früheren Forschungen ist zu ersehen, dass die Artenzahl variirt und zwar nicht nur in Abhängigkeit von der Lokalität, sondern auch von Jahr zu Jahr. So wurde in der Zeit von 1975 bis 7977 eine etwas niedrigere Taxazahl in der Zooplanktonzusammensetzung verzeichnet (PUJIN VLASTA, STANOJEVIĆ MILA, 1979), ein Jahr später eine höhere Rotatorienanzahl (PUJIN VLASTA, RAJKOVIĆ DRAGANA 1979).

Tabelle 1. *Qualitative Zooplanktonzusammensetzung im unteren Theisslauf auf den Profilen A, B, C (1978—1979)*

Arten (Species)	Profile A	Profile B	Profile C
Protozoa			
Amoeba vulgaris Ehrb.	×	×	×
Arcella vulgaris Ehrb.	×	×	×
Aspidisca costata Duj.	×		×
Centropyxis aculeata Stein	×	×	
Difflugia limnetica Lev.	×	×	×
Paramecium aurelia O. F. M.	×	×	×
P. bursaria (Ehrb.)	×		×
P. caudatum (Ehrb.)	×		×
P. trichium Stokes			×
Stylonychia mytilus Ehrb.	×		×
Tinntinopsis lacustris Entz	×	×	×
Vorticella convalaria L.	×	×	×
Rotatoria			
Anueropsis fissa Gosse			×
Asplanchna brightwelli Gosse			×
A. herricki Guerne	×		
A. priodonta Gosse	×		
A. sieboldi (Leydig)	×		
Brachionus angularis Gosse	×	×	×
B. budapestinensis Daday	×		×
B. calyciflorus calyciflorus Pallas	×	×	×
B. calyciflorus amphiceros (Ehrb.)	×	×	×
B. calyciflorus dorcas Gosse	×		×
B. diversicornis Daday	×		
B. leydigii Cohn		×	
B. leydigii rotundus Rouss.	×		
B. quadridentatus cluniorbicularis Skor.	×		
B. urceolaris rubens Ehrb.	×	×	×
Colurella colurus Ehrb.			×
Chromogaster testudo Lauter.			×
Filinia brachiata (Rouss.)	×		
F. longiseta Ehrb.	×	×	×
Keratella cochlearis Gosse	×	×	×
K. cochlearis tecta Gosse	×	×	×
K. quadrata O. F. M.	×	×	×
K. valga (Ehrb.)			×
K. valgà monospina (Klausener)	×	×	×
Lecane bulla Gosse			×
L. lunaris (Ehrb.)			×
Lepadella acuminata (Ehrb.)			×
Notholca acuminata (Ehrb.)			×
N. squamula (Müller)	×	×	×
Polyarthra dolichoptera Idelson	×	×	×
P. major Burckhard	×		×
P. vulgaris Carlin	×	×	×
Rotaria neptunia Ehrb.	×	×	×
R. rotatoria Pallas	×	×	×
Synchaeta pectinata	×	×	×
S. stylata Wierz.	×	×	×
Trichocerca sulcata (Jennings)			×
T. bicristata (Gosse)			×
Trichotria teractis Ehrb.			×

Tabelle 1

Arten (Species)	Profile		
	A	B	C
Cladocera			
Alona quadrangularis O. F. M.			×
Alonella nana (BAIRD)			×
Bosmina longirostris O. F. M.	×	×	×
Daphnia cuculata SARS			×
D. longispina O. F. M.	×	×	
Chydorus sphaericus O. F. M.	×	×	×
Moina micrura (KURZ) SRAM. HUŠ.			×
Copepoda			
Eudiaptomus gracilis G. O. SARS	×	×	×
Acanthocyclops robustus G. O. SARS	×	×	×
A. vernalis FISCHER	×	×	×
Cyclops strenuus FISCHER	×		
C. vicinus ULJANIN	×	×	×
Diacyclops bicuspidatus CLAUS	×		
Eucyclops serrulatus FISCHER			×
Macrocyclops albidus JURINE	×		
Mesocyclops leuckarti CLAUS	×	×	×
Thermocyclops crassus (FISCHER)	×	×	×

Aber diese Variierungen weisen auf keine erheblicheren Veränderungen der Wasserqualität hin. Sie sind mehr durch die Unterschiede in der meteorologischen Verhältnissen bedingt.

Ausser diesen bestehen regelmässig auch die Saisonvariierungen. Manche Arten wie zum Beispiel *Brachionus calyciflorus, Keratella cochlearis* und *Polyarthra dolichoptera* traten das ganze Jahr hindurch, nur mit verschiedenen Populationsdichten. Der grösste Teil der anderen Arten, besonders Rotatoria sind auf die bestimmten Jahreszeiten verbunden. *Brachionus angularis* und *Asplanchna priodonta* erschienen in den kälteren Monaten, wobei die übrigen Rotatoria in den wärmeren Zeitperioden vertreten waren. Die Cladocerenarten, die sich im ganzen Jahr in der Zooplanktonzusammensetzung befinden, ist *Bosmina longirostris,* und unter Copepoden-*Acanthocyclops vernalis* und *Cyclops vicinus. Cyclops strenuus* ist eine Frühjahrsart, und *Thermocyclops crassus* mehr eine Sommerart.

Unter den festgestellten Arten gehörte die höchste Zahl zur Gattung *Brachionus* (7). Die einzelnen Arten dieser Gattung zeichnen sich die Zyklomorphoseerscheinung aus, so dass sie im Laufe des Jahres in mehreren Formen auftreten. So zum Beispiel *B. calyciflorus* ist durch die Formen. *B. cal. calyciflorus, B. cal. amphiceros* und *B. cal. dorcas,* und *B. leydigi* noch durch die *B. leydigi cluniorbicularis* vertreten. *B. urceolaris* ist durch die *B. urceolaris rubens* vertreten. Früher wurden *B. urceolaris* und *B. rubens* als getrennte Arten angesehen, da aber RUTTNER—KOLISKO (1971) feststellte, dass zwischen ihnen keine reproduktive Isolation besteht, werden sie doch als eine Art betrachtet. Die Gattung *Keratella* und *Asplanchna* waren auch mit einer grösseren Arten- und Formzahl vertreten, während die andere Gattungen mit je einer oder zwei Arten gefunden waren.

Ausser der qualitativen Variierungen, zeigen die Zahlwerte eine noch mehr ausgeprägte Dynamik (Tabellen 2., 3. und 4.).

Wie es aus den Daten hervorgeht, liegen die höchsten Werte meist im Sommer oder im Herbst. Es fallen die erheblichen Unterschiede im Zahlenstand im Bezug

Tabelle 2. *Die Zahlwerte des Zooplanktons (Ind/1) in der Theiss auf dem Profil A. (1978—1979)*

Gruppen	1978				1979			
	Frühj.	Sommer	Herbst	Wint.	Frühj.	Somm.	Herbst	Wint.
Protozoa	293	247	216	82	132	140	245	106
Rotatoria	249	360	428	28	161	360	176	94
Cladocera	—	28	8	—	15	9	14	3
Copepoda	27	159	57	11	26	12	19	5
insgesamt:	569	794	709	121	334	461	454	208

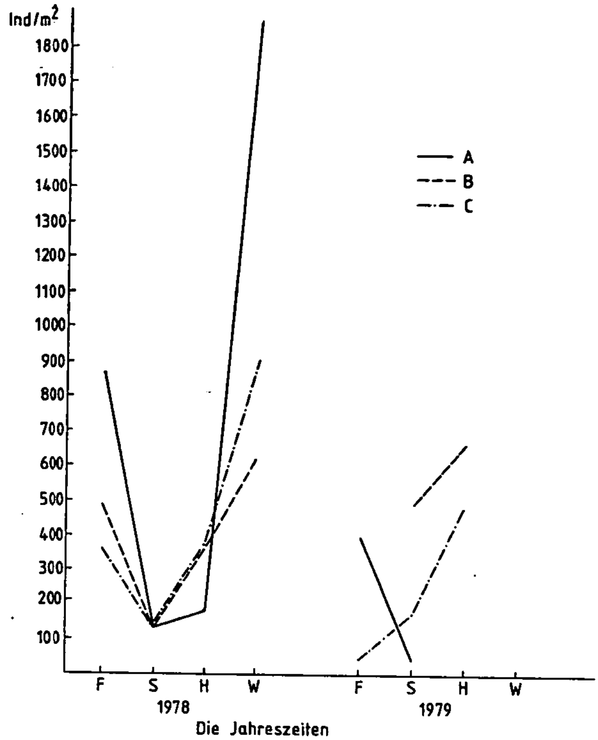
Tabelle 3. *Die Zahlwerte des Zooplanktons (Ind/1) in der Theiss auf dem Profil B. (1978—1979)*

Gruppen	1978				1979			
	Frühj.	Sommer	Herbst	Wint.	Frühj.	Somm.	Herbst	Wint.
Protozoa	103	260	208	90	153	173	133	110
Rotatoria	128	258	155	45	204	240	210	70
Cladocera	—	12	—	—	17	27	20	4
Copepoda	—	26	3	2	28	43	29	17
nsgesamt:	231	556	366	137	402	483	392	201

Tabelle 4. *Die Zahlwerte des Zooplanktons (Ind/1) in der Theiss auf dem Profil C. (1978—1979)*

Gruppen	1978				1979			
	Frühj.	Sommer	Herbst	Wint.	Frühj.	Somm.	Herbst	Wint.
Protozoa	210	512	232	94	110	210	110	61
Rotatoria	148	1372	51	31	62	213	60	25
Cladocera	18	45	—	—	—	16	25	—
Copepoda	144	207	2	—	23	33	120	10
insgesamt:	520	2136	285	125	195	472	315	126

auf die untersuchten Jahre auf. Die erheblich höheren Werte wurden im Jahre 1978 (Graph. 1) verzeichnet. Es werden auch die Unterschiede nach den Profilen gewahr. Die höchsten Werte werden auf dem Profil C. notiert, etwas niedrigere auf dem Profil A. und die niedrigsten auf B. In den Zahlwerten überwiegen die Protozoen und Rotatorien. Cladoceren und Copepoden traten sehr unausgeglichen auf, und in manchen Aspekten wurden sie in den Proben nicht herausgefunden. Die Unterschiede in der quantitativen Zusammensetzung auf manchen Untersuchungsstellen sind wahrscheinlich, unter anderem, die Folge des Einflusses der Theisszuflüsse, vor allem Begej, der wegen der grossen Belastung mit den industriellen Abwässern zur grösseren Eutrophierung der einzelnen Regionen der Theiss führt.



Graph. 1

Die Bodenfauna

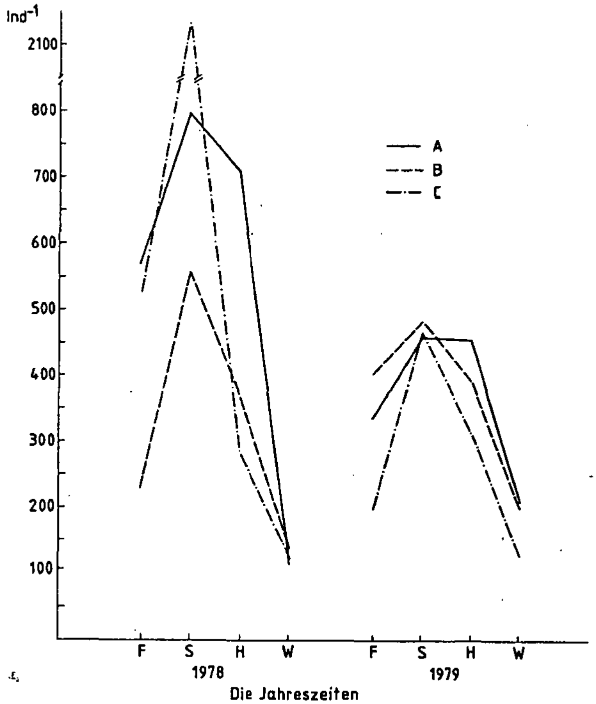
In der Bodenfauna wurden zwei Gruppen vertreten: Oligochaeta und Chironomida. Die Oligochaeten waren dominierend und innerhalb dieser Gruppe wurde die Bestimmung bis zur Art durchgeführt. Chironomiden wurden nicht ausführlicher bearbeitet.

Unter Oligochaeten wurden folgende Arten festgestellt: *Paranais litoralis* (MÜLLER), *P. uncinata* ÖRSTED, *Dero obtusa* (UDEK.), *Limnodrilus claparedeanus* (UDEK.), *L. hoffmeisteri* (CLAPARED), *Limnodrilus* sp., *Potammotrix hammoniensis* (MICHEL). *Tubifex tubifex* (MÜLLER), *Tubifex* sp., *Isochaeta michaelsoni* (LASTOCKIN), *Limnodrilus helveticus* (MICHEL.), *Ilyodrilus perrieri* (EISEN), *Branchyura sowerby* (BEDDARD). Die juvenilen Stadien wurden nicht bis zur Art bestimmt, sondern als sp. bezeichnet.

Die dominierende Art war *Limnodrilus hoffmeisteri* in der Zusammenheit mit *Tubifex tubifex,* augeprägt in manchen Perioden und nach LIBMANN (1962) und SLADAČEK (1973) stellen eine Verbundenheit dar unter den Bedingungen einer stärkeren organischen Verunreinigung.

Die quantitative Zusammensetzung der Bodenfauna variierte abhängig von der Lokalität, Saison und von dem Jahr (Tabelle 5., Graph. 2).

In der Bodenfauna, wie auch bei Zooplankton, werden die höheren Werte im Jahre 1978 bemerkt. Die Ausnahme stellt das Profil B, bei dem die Werte im Sommer und im Herbst im 1979 höher sind als die im Jahre 1978. Die Vermehrung der Oligochaetenanzahl ist mit der Anwesenheit der grösseren Menge der organischen



Graph. 2

Tabelle 5. *Die quantitative Zusammensetzung der Bodenfauna des ufernahen Regions der Theiss (ind/m²) auf den Profilen A, B, C (1978—1979)*

GRUPPEN	Profil A		Profil B		Profil C	
	1978	1979	1978	1979	1978	1979
Frühjahr						
Oligochaeta	867,8	310,8	310,8	—	310,8	44,4
Chironomida	—	88,8	44,4	—	177,6	—
insgesamt:	876,8	399,6	355,2	—	488,4	44,4
Sommer						
Oligochaeta	133,2	44,4	133,2	488,4	133,2	133,2
Chironomida	—	—	—	—	—	44,4
insgesamt:	133,2	44,4	133,2	488,4	133,2	177,6
Herbst						
Oligochaeta	177,6	—	355,2	666,0	355,2	488,4
Chironomida	—	—	—	—	—	—
insgesamt:	177,6	—	355,2	666,0	355,2	488,4
Winter						
Oligochaeta	1864,8	—	621,6	—	888,0	—
Chironomida	—	—	—	—	—	—
insgesamt:	1864,8	—	621,6	—	888,0	—

Stoffe im Schlamm verbunden. Die ähnliche Variierungen in diesem Fluss sind auch früher festgestellt worden (DJUKĆ NADA, 1979).

* * *

Auf Grund der Untersuchungen der Zusammensetzung des Zooplanktons und der Bodenfauna an drei Profilen (A, B, C) im unteren Theisslauf in den Jahren 1978—1979 kann folgendes beschlossen werden:

An der qualitativen Zooplanktonzusammensetzung nehmen teil: Protozoa, Rotatoria, Cladocera und Copepoda. Es werden insgesamt 68 Taxa festgestellt, davon 12 Protozoa, 39 Rotatoria, 7 Cladocera und 10 Copepoda.

Die Artenzahl variierte in der Abhängigkeit vom Profil, Saison und vom Jahr. Die höchste Zahl war auf den Profil C vorhanden (54), dann auf dem Profil a (48), und auf C (31).

Die höchste Zooplanktonentwicklung wurde in der Sommer- oder in der Herbstzeit festgestellt. Die Zahlwerte aus dem Jahr 1978 waren höher als die Werte im Jahre 1979.

Die Bodenfauna wurde durch die Oligochaeta und Chironomida vertreten. Oligochaeten waren dominierend und sie waren vertreten mit 11 Arten.

Auch bei Bodenfauna waren die Variierungen ausgeprägt, abhängig von Lokalität, Saison und von dem Jahr. Mit der Ausnahme auf dem Profil B, wurden in der Boden fauna die höheren Werte im Jahre 1978 verzeichnet.

Die Verbundenheit der Arten *Limnodrilus hoffmeisteri* und *Tubifex tubifex* in den ufernahen Regionen in manchen Perioden weist auf eine stärkere organische Verunreinigung hin.

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Az Alsó-Tisza szakasz zooplankton és fenékfauna összetétele és dinamikája

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Biológiai Intézet, Újvidék (Novi Sad)

Kivonat

Az 1978—1979-ben az Alsó-Tisza szakasz három profilján — A, B, C, végzett zooplankton és fenékfauna vizsgálata alapján a következőket állapították meg a szerzők:

A 68 faj és varietas közül 12 Protozoa, 39 Rotatoria, 7 Cladocera és 10 Copepoda tartozék. A fajok száma profilonként változó: az A profilon 48 faj, a B-n 31, a C-n 54 faj volt jelen. A zooplankton mennyiségi összetételét idő és térbeli különbség jellemzi, a nyári és őszi maximális értékekkel. A korábbi kutatásokhoz viszonyítva csökken a Rotatoria fajok száma.

Az Oligochaeta és Chironomida-k közül az Oligochaeta-k a dominások a fenékfaunában. 11 Oligochaeta faj került elő. Az Oligochaeta-k számbeli jelenlétét szintén idő és térbeli ingadozás jellemzi. A *Limnodrilus hoffmeisteri* és a *Tubifex tubifex* együttes időszakos előfordulása a partmenti övezetben, magas szintű szerves anyagokkal való szennyeződésre utal.

Состав и динамика зоопланктона и фауны дна в нижнем течении реки Тисы

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Резюме

В продолжение 1978—1979 гг. исследовали состав и динамику фауны дна в нижнем течении реки Тисы на трёх профиях (А, Б, и Ц). Представителями в зоопланктоне были группы: Protozoa, Rotatoria, Cladocera и Copepoda. Установлено всего 68 таксонов, из того 12 Protozoa, 39 Rotatoria, 7 Cladocera, и 10 Copepoda.

Число видов колебалось в зависимости от профилей, сезона и года. Найбольшее число было в наличии на профиле Ц (54), затем на профиле А (48) и на Б (31). Максимальное развитие зоопланктонов усиановлено в летнем и в осеннем периодах. Номинальные значения в 1978 году были больше значений в 1979 г.

Представителями фауны дна были группы: Oligochaeta и Chironomida, из которых первые были доминирующими. С исключением на профиле Б, тоже в фауне отмечены большие значения в 1978 году. Общность видов *Limnodrilus hoffmeisteri* и *Tubifex tubifex* в побережном районе в отдельных периодах указывает на более сильные органические загрязнения.

Sastav i dinamika zooplanktona i faune dna u donjem toku reke Tise

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Abstrakt

U toku 1978—1979 ispitivani su sastav id dinamika zooplanktona i faune dna u donjem toku reke Tise na tri profila (A, B, C). U zooplanktonu su bile zastupljene grupe: Protozoa, Rotatoria, Cladocera i Copepoda. Ukupno je konstatovano 68 taksona, od toga 12 Protozoa, 39 Rotatoria, 7 Cladocera i 10 Copepoda.

Broj vrsta je variirao zavisno od profila, sezone i godine. Najveći broj je bio prisutan na profilu C (54), zatim na A (48) i C (31). Maksimalan razvoj zooplanktona konstatovan je u letnjem ili jesenjem periodu. Numeričke vrednosti u 1978 godini bile su vece od vrednosti u 1979.

Fauna dna je bila zastupljena grupama: Oligochaeta i Chironomida, od kojih su prve bile dominantne. Izusev na profilu B, i u fauni dna su zabeležene veće vrednosti u 1978 godini. Zajedništvo vrsta *Limnodrilus hoffmeisteri* i *Tubifex tubifex* u priobalnom regionu u pojedinim periodima ukazuju na jača organska zagadjenja.

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HYDROECOLOGY OF THE GRASS-ASSOCIATIONS FOUND AT THE DAMS ALONG THE UPPER-TISZA

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Abstract

To this day, the grass stands developing at the dams of the Upper Tisza-valley by means of sowing performed close to one century ago, have come close to the populations of the alpine meadows. Their zonal arrangement is determined by the frequent, but short-termed inundations and the exposition of the dam-slope. A significant variation was demonstrable compared to the similarly located dam grass zones found at the Southern Tisza-valley.

1. *Alopecuro-Arrhenatheretum* developed on the effect of repeating floods in the lower zones of the Northern-, North-Eastern dam-slope. The helo-hygrophyton and hygrophyton representatives were dominating.

2. *Pastinaco-Arrhenatheretum* was found located at the upper zone of the dam-slope. Depending on the moisture conditions, three sub-associations could be distinguished and the species belonging to the various subunits of the hygro-mesophyton category were demonstrable.

3. The *Lolio-Plantaginetum* developed on enhanced zoogenic effect at the dam's Western-, South-Western flood-protected area.

4. The zone of the *Salvio-Festucetum rupicolae* could be differentiated into four sub-associations and occupied the central and upper protected dam zone. Their species components were meso-xerophyton representatives.

Introduction

During the course of the geological periods, the process of down-cast fault and alluvial deposit took place at the Great Hungarian Plain section of the Carpathian Basin. As a consequence, this plain became evenly sloped in Southern direction. The rainwater gathering from the environs also proceeds in this direction. The transmitter of these periodically high water masses is the second largest river of the country, the Tisza.

In the past centuries, mainly in the XVII.,—XVIII. centuries, the South-Eastern Lowland turned to flood-area in the Spring months following snowbreak. To prevent this, dam systems were established. On their effect developed the so-called flood-plain formed between the dams, and dominated by the repeating floods of various durations; as well as the flood area outside of the dam, free from floods. Regarding the soil relations of these two separated areas, significant variation also developed during the course of the decades. While in the flood-plain zone the repeatedly formed mud layers from the floods established young irrigation soil without structure, at the protected flood area meadow soil of irrigation nature developed with the outset of the soil development. The dams having conspicuous relief extend between these two as a boundary line.

Well distinguishable grass-associations developed during the course of the past century at their slopes and zones, respectively, exposed to different environmental-biological effects. The species components found here reflect well the variations in duration and effect of climate, exposition (BODROGKÖZY et *al.* 1967) and flood level. Significant differences were also found due to the varying macroclimatic relations when comparing the climatic relations of the Northern and Southern Lowlands. Taking all these into account, significant variation could be determined during the course of the analysis and comparison, respectively, of the grassassociations at the dam zones of the Northern, as well as the Southern Tisza-valley (BODROGKÖZY 1966, 1968).

These dam system were protected from the flood and rainwater erosions by grass coverings established by means of sowing, applying uniform seed-mixtures. The possibilities available against flood control have been reported by SZALAY (1959), GRUBER (1970) and SZARVAS (1970). During the course of the past decades, however, this cultura grass stand overwent significant changes in composition. Nowadays it is becoming all the more similar to the composition of the damp-, fresh- and dry meadows known both from Hungarian and foreign literature, the majority of which are also of secondary origin. Therefore, these can now be regarded as related to or same as those. This conclusion could be drawn when comparing the meadows and pastures found at the environs of the South Hungarian Mecsek (HORVÁT 1960) with the date of the Hungarian publications originating from the environments of Gödöllő at the Central range of mountains and the border of the Lowlands (KOVÁCS 1954), the area alongside the Rába (JEANPLONG 1960, 1970), the environs of Buda (ZÓLYOMI 1958) or from the Eastern Central range of mountains (MÁTHÉ and KOVÁCS 1960).

Materials and Methods

In respect to the Northern-Lowlands, the phytocenological and hydroecological studies on dam-grasses ranged North from Vásárosnamény to the frontier of the Soviet Union. By means of the regular phytocenological surveyings, the upper gradient zone of Eastern exposition located near the water, affected by floods and free from waters, was separated from the lower-, central- and upper zones of Western exposition, located at the protected side. There was also possibility for comparative analysis regarding the dam-grasses of similar location at the Southern Lowlands.

From hydroecological viewpoint, the grouping and evaluation of the species components of the various grass stands could be accomplished with the aid of the methods used earlier (ZÓLYOMI et al. 1967: W factor; ELLENBERG 1979, SOÓ 1964—80: F factor; BODROGKÖZY 1982a, b). The analyses also comprised the covering quota of the various species within the different associations, since the hydroecological diagram of each species was also constructed. These curves — mirroring the moisture demands — also demonstrate the ecological adaptability of the certain species. The representatives in which case the culmination points of their curves are under 50%, have wide hydroecological adaptability, being less characteristic to the site relations in question, and vice versa (Fig. 2).

Discussion

Figure 1 demonstrates the studied grass stands which developed depending on the macroclimate exposition- and zone condition at the Northern Hungarian Tisza-valley dams.

1. *Alopecuro pratensis — Arrhenatheretum* (MÁTHÉ and KOVÁCS (60) SOÓ 71.

Along the Upper-Tisza the river floods are more frequent but not so long-lasting as in the Southern lowland section. This explains the reason why the lower zone of the dam-side next to the water is not covered by water for longer duration. Therefore, in the place of the originally sown *Arrhenatherum — Dactylis—Bromus* grass composition, after the destruction of the species being more sensitive against the covering

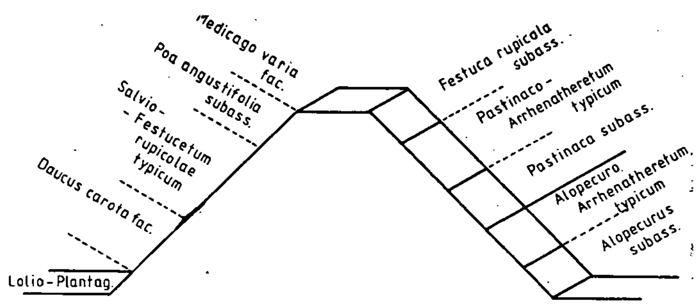

Fig. 1. Zonation system of the grass association found at the dams located at the Northern Tisza-valley.

by water, the species components characteristic of this association became settled at this area, like the *Rumex acetosa, Daucus carota, Poa angustifolia.* The grass stand of the dam zone exposed to this flood effect can be separated into three units of association:

1.1. *A.-A. alopecuretosum pratensis* MÁTHÉ and KOVÁCS 60.

This is situated at the lower section of the flood water zone, at the place where the covering by water is of relatively longer duration and the soil of the dam is more deeply humid. This is reflected by the distribution of the characteristic species. The nitrophylic *Arrhenatheretum* stands reported from the Matopolska Plato meadows of Poland are somewhat similar (MEDWECKA-KORNAS, A. 1959). The meadows rich in nutriments are well known from the district of Brün (BALÁTOVÁ—TULÁCKOVÁ 1968), from which area the seasonal changes of the underground water level are also known from the Fifties. Their secondary stands from the environs of Stechlinsee in Germany have been reported as *Dauco-Arrhenatheretum* (BR.—BL. 19) OBD. 65, where even the *Alopecurus pratensis* forms a sub-association (KRAUSCH 1966, 1967).

The similarly secondary meadows at the South-Western territory developing at Transdanubia (Zala county) also have distinguishable types; namely, one characterisable by the more damp *Alopecurus pratensis* and one being drier: the *Poa angustifolia* (ÚJVÁROSI 1947). In the North Hungarian (Mátra Mountains) secondary stands having moist soil, the *Alopecurus pratensis* sub-association was described through

Cenological relations

Regarding the average of their phytocenological pictures, the strictly taken Alopecurion, Molinion and Molinietalia representatives were generally only found in blades, however, the Arrhenatherion species played role with higher species number and covering quota, and the Molinio-Arrhenatherea species played role in the highest species number and covering quota (Table 1 and 2).

Hydroecological situation

On the effect of the frequent, but short durational inundations certain helo-hygrophyton and hygrophyton representatives appeared, like the *Galium rubioides, Vicia cracca* and the *Viola elatior* as the representatives of the flood-plain marsh-meadows, with low covering quota. Otherwise, the hydroecological curve of the sub-association shows double culmination point. The total covering quota of the denominating *hgm1*-like species components is higher, first of all, that of the *Alopecurus pratensis,* showing a transition towards the hygrophylic category. From the view-

Table 1. *Alopecuro pratensis — Arrhenatheretum 1. alopecuretosum (typicum)*
2. poëtosum angustifoliae

F	W	sub-assaciation	1	2
		Helo-hygrophyta:		
		hhg1		
4	8	*Angelica silvestris* (Molinietalia)		
4		*Galium rubiodies* (Alopecurion pratensis)		
		Hygrophyta:		
		hg2, 3		
0	4	*Vicia cracca* (Molinio-Arrhenatherea)		
3—4	5	*Viola elatior* (Molinietalia)		
		Hygro-mesophyta:		
		hgm1		
3	8	*Alopecurus pratensis* (Molinio-Arrhenatherea)		
3—4	4	*Serratula tinctoria* (Molinion)		
0	7	*Ranunculus acris* (Molinio-Arrhenatherea)		
	8	*Equisetum arvense* (Secalietea)		
		hgm2		
3—4	6	*Pastinaca sativa* ssp. *pratensis* (Molinio-Arrhen.)		
3	5k	*Campanula patula* ssp. *neglecta* (Molinio-Arrhen.)		
		Mesophyta:		
		m1		
0	6	*Dactylis glomerata* (Molinio-Arrhenatherea)		
3	4	*Anthoxanthum odoratum* (Festuco-Brometea)		
3	5	*Pimpinella major* (Arrhenatheretalia)		
2—4	2	*Rumex acetosa* (Molinio-Arrhenatherea)		
0	3	*Convolvulus arvensis* (Chenopodio-Scleranthea)		
		m2		
3	5	*Arrhenatherum elatius* (Arrhenatherion)		
3	5	*Plantago media* (Molinio-Arrhenatherea)		
		m3		
0	5	*Daucus carota* (Molinio-Arrhenatherea)		
0	6	*Leontodon hispidus* ssp. *hastilis* (Molinio-Arrhen.)		
		Meso-xerophyta:		
		mx1		
2	3	*Bromus inermis* (Festuco-Brometea)		
0	5	*Cichorium intybus* (Molinio-Arrhenatherea)		
2—3	5a	*Knautia arvensis* (Molinio-Arrhenatherea)		
0	3	*Clinopodium vulgare* (Querco-Fagea)		
2	5a	*Tanacetum vulgare* (Calystegion)		
3		*Cruciata levipes* (Quercetea)		
2	3	*Trifolium montanum* (Festuco-Brometea)		
3	5k	*Inula salicina* (Molinio-Arrhenatherea)		
0	3	*Genista elata* (Festucetalia valesiacae)		

F	W	sub-assaciation	1	2
		mx2		
2	3	*Poa angustifolia* (Festuco-Bromea)		
1—2	3	*Coronilla varia* (Festuco-Brometea)		
3	5	*Agrimonia eupathoria* (Festuco-Brometea)		
2—3	4	*Plantago lanceolata* ssp. *sphaerostachya* (Festuco-Bromea)		
0	3	*Pimpinella saxifraga* (Festuco-Bromea)		
1—2		*Cuscuta epithymum* (Festuco-Bromeea)		
2—3	5	*Vicia sepium* (Molinio-Arrhenatherea)		
2	1	*Festuca rupicola* (Festuco-Bromea)		
		mx3		
2	3	*Fragaria viridis* (Festucetalia valesiacae)		
2—3	3	*Viola hirta* v. *fraterna* (Festuco-Bromea)		

Symbols: D-value:

25—50 %
5—25 %
1— 5 %
0,5— 1 %

(The symbols apply to table 1., 4., 6., 7)

Table 2. *Distribution according to cenosystematic units of the species number and covering quota of the species components of the association*

	Species number		Covering quota	
	1	2	1	2
Alopecurion pratenisis	1	.	1	.
Molinion	1	.	0,5	.
Molinietalia	2	.	2	.
Calystegion	.	1	.	1
Arrhenatherion	1	1	20	20
Arrhenatheretalia	1	.	1	.
Molinio—Arrhenatherea	12	9	61	39
Secalietea	1	1	1	1
Chenopodio-Scleranthea	.	1	.	5
Festucetalia valesiacae	2	2	2	3
Festuco-Brometea	4	4	6	9
Festuco-Bromea	.	7	.	34
Quercetea, Querco—Fagea	1	2	1	2

the *Festuca pratensis Cardamine pratensis, Poa trivialis* separative species, which are similar to those found around the environs of the Mecsek (Máthé—Kovács 1960). The subunits of the associations reported from the alluvial areas of the French mediterranean Montpellier region differ from the composition of the meadows found at Central and Eastern Europa (Ilijanic 1965).
point of species number the majority of the mesophyta belong to the *m1* subgroup. The secon dculmination point, however, is firstly formed by the *Arrhenatherum elatius* from the *m2* subgroup (Fig. 3). From the *m1*-s the *Anthoxanthum odoratum, Pimpinella major, Rumex acetosa* are mainly characteristic of the dams located ilongside the Upper-Tisza, and have shown good adaptability to the periodical anundations.

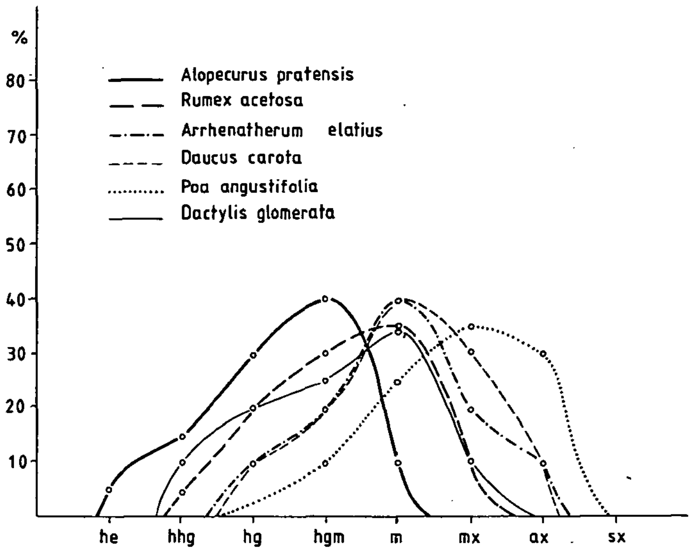

Fig. 2. The hydroecological curves of the more important species of the *Alopecuro-Arrhenatheretum.*

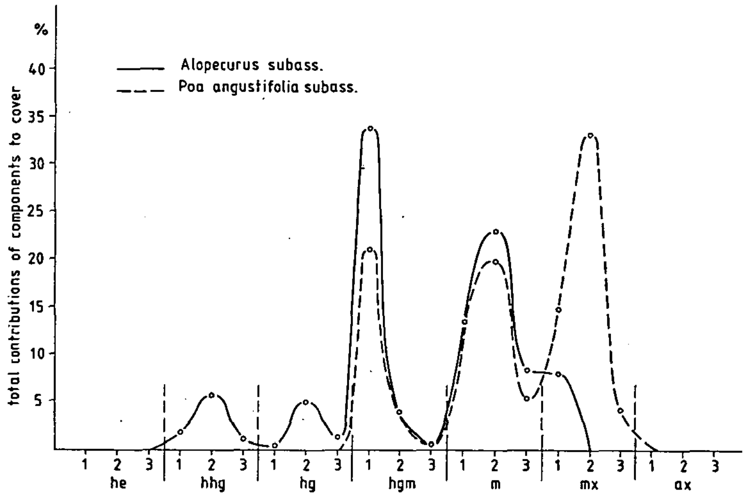

Fig. 3. Comparative distribution of the association-units according to covering quota.

Analysing the hydroecological curves of the species characteristic to the sub-association, it could be determined that these have a wider ecological adaptability. This explains the reason why the peak of their curve does not overreach the value of 40% (Fig. 2).

1.2. *A.—A. poëtosum angustifoliae* (n. nov.)

Environmental-biology: In the case when the dam follows the river bends in such manner that the slope from the side of the water has a Southern-, South-

Western exposition, the species composition of the grass covering changes. It does not always cover exquisitely and frequently, in the case of the development of inundation, the danger of soil erosion may arise.

Cenological relations

In their cenoses the Festuco-Brometea species of wider ecological adaptability have become more wide-spread. Concerning their covering quota, they have a dominative role. Their differential species are the *Poa angustifolia, Agrimonia eupathoria, Pimpinella saxifraga.* In the Autumn aspect, the Festuco-Brometea representative, the *Cuscuta epithymum* causing destruction in smaller-larger patches, has gained larger ground at places (Table 1).

The relationships between the species number and covering quota of the various cenosystematic units are well followable on Table 2.

Hydroecology

After the subsiding of the smaller floods which vary from those at the Lower-Tisza section (Bodrogközy 1966, 1968), and mainly on the effect of the more increased insolation, the helo-hygrophyta and the hygrophyta disappear in the Summer period. Their place is occupied by the meso-xerophyta which is richer in species and has higher covering quota. Even from these, the denominator of the sub-association, the *mx2*-like *Poa angustifolia,* having wide hydroecological amplitude, is highly conspicuous.

The majority of the characteristic species, however, are mesophyta. Nevertheless, it should be added that the culmination points of their hydroecological curves show values of 40% or below this. Accordingly, they could also develop in the company of the meso-xerophyton and even in that of the asteno-xerophyton representatives, living at the sometimes damper, other times drier dam-slopes. The *Arrhenatherum elatius* is such a species.

Its hydroecological curve constructed on the basis of the total covering quota of the two association-units shows three culmination points (Fig. 3).

1.3. *A.—A. arrhenatheretosum* (typicum)

The cenosis located between the zone of the previous two sub-associations. Since good separation is rarely possible at the area chosen for study, here the evaluation had to be disregarded. It has been studied from other areas, firstly from practical aspects. Therefore, it is known on the basis of the reports by Schneider (1954), Ellenberg (1952), Máthé (1956), Schubert et *al.* (1959).

2. *Pastinaco—Arrhenatheretum* (Knapp 54) Passr. 64
(Syn.: *Dauco-Arrhenatheretum* Görs 66)

This has developed in the zone located upwards from the long-standing flood level at the slopes of Northern-, North-Eastern exposition of the dams along the Upper-Tisza. Thus, the two hayfield associations described by Máthé and Kovács (1960) can be found at the studied area above each other, in zonal arrangement. In their stands established close to one century ago, essentially more sepcies have developed during the course of the past decades at this dam section, than at the lower zone exposed to the selective effect of floods.

The cenosystematic analysis evidenced that here also the greatly accomodating Molinio-Arrhenatherea are the frequent representatives, both in respect to species

Table 4. *Pastinaco — Arrhenatheretum elatioris 1. pastinacetosum 2. arrhenatheretosum (typicum) 3. festucetosum rupicolae*

F	W	Sub-association:	1	2	3
		Helo-hygrophyta: *hhg1, 2*			
3—4	8	*Lysimachia nummularia* (Mol.-Juncetea)	■		
4	7	*Lathyrus pratensis* (Molinio-Arrhenatherea)	—		
4	8	*Angelica silvestris* (Molinio-Juncetea)	—		
		Hygrophyta: *hg1, 2, 3*			
3—4	7	*Carex hirta* (Molinio-Arrhenatherea)	—		
3—4	6	*Potentilla reptans* (Molinio-Arrhenatherea)	■		
4	9	*Calystegia sepium* (Calystegion)	—		
2—4	4	*Vicia cracca* (Molinio-Arrhenatherea)	■		
3—4	8	*Stenactis annua* (Calystegion)	■	—	—
		Hygro-Fmesophyta: *hgm1*			
2—4	7	*Ranunculus acris* (Molinio—Arrhenatherea)	■	—	
3—4	8	*Galega officinalis* (Molinietalia)	—		
2—3	7	*Glechoma hederacea* (Molinio-Arrhenatherea)	■	—	—
0	8	*Equisetum arvense* (Secalietea)	■		
		hgm2			
3—4	6	*Pastinaca sativa* ssp. *pratensis* (Molinio-Arrhenatherea)	■	—	—
2—3	3	*Galium mollugo* (Molinio-Arrhenatherea)	■	■	—
3—4	6	*Prunella vulgaris* (Plantaginetea)	—	■	
0	8	*Rubus caesius* (Salicetea)	—		
3		*Cuscuta europaea* (Calystegion)	—		
3—4	5	*Campanula patula* ssp. *neglecta* (Molinio-Arrhenatherea)	—		
		hgm3			
3	4	*Aristolochia clematitis* (Calystegion)	■	■	—
4—5	8	*Rorippa austriaca* (Agropyro-Rumicion)	—		
2—3	5	*Rumex crispus* (Agropyro—Rumicion)	—		—
		Mesophyta: *m1*			
0	6	*Trifolium repens* (Molinio-Arrhenatherea)	■	■	■
0	5	*Lotus corniculatus* (Molinio-Arrhenatherea)	■	■	
0	4	*Rumex acetosa* (Molinio-Arrhenatherea)	■	■	■
2—3	2	*Convolvulus arvensis* (Chenopodio-Scleranthea)	■	■	■
0	3	*Taraxacum officinale* (Molinio-Arrhenatherea)	■	■	■
2—3	5	*Centaurium erythraea* (Molinio-Arrhenatherea)	■	■	—
2—3		*Centaurea jacea* (Molinio-Arrhenatherea)	—	—	
2—3		*Oxalis fontana* (Chenopodio-Scleranthra)	—		
2—3	6	*Knautia drymeia* (Fagetalia)	—		
3	6		—		
		m2			
3	5	*Arrhenatherum elatius* (Arrhenatherea)	■	■	■
2—3	4	*Medicago sativa* (Festuco-Brometea)	—	■	■
3	5	*Plantago media* (Molinio-Arrhenatherea)	—	—	—
0	6	*Trifolium pratense* (Molinio-Arrhenatherea)	—	—	—
0		*Verbascum blattaria* (Arrhenatherion)			
		m3			
0	5	*Daucus carota* (Arrhenatherion)	■	■	■
2—3	3	*Agropyron repens* (Chenopodio-Scleranthea)	■	■	■
2—3	4	*Silene alba* (Chenopodio-Scleranthea)	■	■	■
		Dactylis glomerata (Molinio-Arrhenatherea)			

		Sub-association:	1	2	3
0	6	*Leontodon hispidus* ssp. *hastilis* (Molinio-Arrhenatherea)	—	▬	—
2—3	4	*Tanacetum vulgare* (Calystegion)	—	—	—
3	4	*Setaria lutescens* (Agropyro-Rumicion)	—		
2—3	6	*Heracleum sphondylium* (Molinio-Arrhenatherea)	—		
2—3	4	*Stellaria graminea* (Molinio-Arrhenatherea)	—		
		Meso-xerophyta: *mx1*			
0	5	*Cichorium intybus* (Molinio-Arrhenatherea)	—	▬	▬
0	4	*Trifolium campestre* (Festuco-Brometea)	—	—	▬
2—3	3	*Silene vulgaris* (Molinio-Arrhenatherea)	—	—	▬
2—3	2	*Picris hieracioides* (Festuco-Bromea)		—	▬
2—3	4	*Tragopogon dubius* ssp. *major* (Festuco-Brometea)	—	—	—
2—3	5	*Cerastium fontanum* ssp. *triviale* (Molinio-Arrhenathera)		—	—
2—3	3	*Agrimonia eupatoria* (Festuco-Brometea)	—		
2	3	*Astragalus cicer* (Festucion rupicolae)		—	
2	3	*Vicia pisiformis* (Quercetalia)		—	
		mx2			
2	3	*Poa angustifolia* (Festuco-Bromea)		▬	▬
1—2	3	*Coronilla varia* (Festuco-Brometea)	—	▬	▬
2—3	4	*Plantago lanceolata* (Festuco-Bromea)		—	▬
1—2		*Cuscuta epithymum* (Festuco-Brometea)		—	▬
2	2	*Achillea collina* (Chenopodio-Scleranthea)			▬
1—4	3	*Pimpinella saxifraga* (Festuco-Bromea)			—
1—2	3	*Erodium cicutarium* (Festuco-Bromea)			—
2—3	5	*Astragalus glycyphyllus* (Querco-Fagea)		—	—
2—3	3	*Carduus acanthoides* (Festuco-Brometea)			—
2	3	*Echium vulgare* (Festuco-Brometea)			—
		mx3			
2	1	*Festuca rupicola* (Festuco-Bromea)			▬
1—2	1	*Thymus serpyllum* (Festuco-Sedetalia)			▬
1—2	2	*Potentilla argentea* (Festuco-Bromea)			—
2	3	*Fragaria viridis* (Festucetalia valesiacae)			—
2—3	3	*Veronica teucrium* (Festucetalia valesiacae)			—
1—2	2	*Trifolium arvense* (Festuco-Bromea)			—
2—3	4	*Erigeron canadensis* (Chenopodio-Scleranthea)			—
2	3	*Nonea pulla* (Festucion rupicolae)			—
2	2	*Centaurea sadleriana* (Festucetalia valesiacae)			—
2—3	3	*Viola hirta* v. *fraterna* (Festuco-Brometea)			—
1—2	3	*Anchusa officinalis* (Chenopodietea)			—
2—3	3	*Verbascum nigrum* (Quercetea)			—
		Asteno-xerophyta: *ax1*			
1—2	3	*Medicago varia* (Festuco-Brometea)			▬
1	1	*Sedum sexangulare* (Festuco-Bromea)			—
		Calamintha clinopodium (Cluerco Faged)			—
2	2	*Centaurea micranthos* (Festucion vaginatae)			—

number and covering quota. Progressing upwards along the dam-slope, the Festuco-Brometea and the Festuco-Bromea species, respectively, have become dominating. The Quercetea and Querco Fagetalia species at the gallery-forest zone stretching near the dam are frequently found in their cenoses, mostly in the form of blades. Such are the *Knautia drymea, Vicia pisiformis, Verbascum nigrum.* Due to the changes in the species composition taking place in their certain cenoses, three association-units could be separated.

2.1. *P.—A. pastinacetosum* (n. nov.)

This species is located at the lower section of this dam-meadow zone, showing a transition towards the zone of the previous association.

Cenological relations

The certain Molinio-Juncetea and Calystegion representatives frequently appearing in blades are characteristic. Their differential species are the *Vicia cracca, Ranunculus acris, Angelica silvestris.* This latter, being mainly a brook-shore, marsh-meadow species, would rather have been expected at the lower zone of the dam. It is assumed that the water covering of longer duration would be disadvantageous for this species. Certain Agropyro-Rumicion species, like the *Rorippa austriaca, Rumex crispus, Setaria lutescens* could also be found, although their total covering quota was not significant. Nevertheless, both concerning species number and covering quota, more important is the presecne of the Chenopodio-Scleranthea and Festuco-Brometea, still partly missing from the lower dam-zone. (Table 3).

Hydroecology

Since this sub-association is adjacent to the lower zone of the *Alopecuro-Arrhenatheretum* at the central zone of the dam-meadow, the total covering quota of the hygromesophyton representatives is significant. From the latter the *hgm1* and mainly the *hgm2* species are regarded as being frequent, like the *Ranunculus acris, Equisetum arvense,* the denominative *Pastinaca sativa* ssp. *pratensis* and the *Galium mollugo* (Fig. 7).

Table 3. *Comparative evaluation of the three sub-associations of the Pastinaco-Arrhenatheretum in respect to species number and covering quota*

	Species number			Covering quota		
	1	2	3	1	2	3
Molinio-Juncetea	2	.	.	3	.	.
Molinietalia	1	.	.	1	.	.
Arrhenatherion	2	1	1	35	50	25
Molinio-Arrhenatherea	25	16	13	45	31	18
Calystegion	5	3	3	7	4	2
Plantaginetea	1	1	.	0,5	3	.
Agropyro-Rumicion	3	.	1	2	.	1,5
Chenopodietea	.	.	1	.	.	0,5
Chenopodio-Scleranthea	4	3	5	10	7	15
Festucion rupicolae	.	1	1	.	0,5	0,5
Festucion vaginatae	.	.	1	.	.	2
Festuco-Brometea	5	5	8	4	8	15
Festuco-Bromea	.	3	10	.	7	34
Festuco-Sedetalia	.	.	1	.	.	3
Querco-Fagea, Quercetalia, Quercetea	3	2	2	5	1	1

Regarding moisture-demand the highest values were shown by the mesophyton components. Dividing the 75% total covering quota of the species of this category into subgroups, the following succession appeared: *m2*, *m1*, *m3*. Among the *m1*-s, the prominent species are the *Dactylis glomerata* and the *Trifolium repens* remaining from the halfculture period. The weeds occupying the sown but exterminated ones are the *Convolvulus arvensis, Taraxacum officinale,* etc. From the *m2*-s, the *Arrhena-*

Table 6. *Lolio-Plantaginetum majoris.*
1. plantaginetosum majoris 2. lolietosum perennis 3. portulacetosum

F	W	Sub-association:	1	2	3
		Helo-hygrophyta:			
		Hygrophyta:			
		hhg3, hg1			
3—4		*Rorippa sylvestris* (Agropyro-Rumicion)	■		
4	8	*Mentha pulegium* (Agropyro-Rumicion)	■	—	
		hg2, hg3			
4—5	8	*Ranunculus sardous* (Agropyro-Rumicion)	■	—	
3—4	6	*Potentilla reptans* (Agropyro-Rumicion)	■	—	
3	7	*Festuca pratensis* (Molinio-Arrhenatherea)		—	
		Hygro-mesophyta:			
		hgm1			
2—3	7	*Plantago major* (Plantaginetea)	■	■	■
2—3	5	*Alopecurus pratensis*		■	
2—3	7	*Glechoma hederacea* (Molinio-Arrhenatherea)	■	—	
2—3	6	*Leontodon autumnalis* (Molinio-Arrhenatherea)	■	—	
		hgm2			
0	8	*Poa annua* (Chenopodio-Scleranthea)	■		
3—4	6	*Prunella vulgaris* (Plantaginetea)		■	
2—3	3	*Galium mollugo* (Molinio-Arrhenatherea)		■	—
3—4	6	*Pastinaca sativa* (Molinio-Arrhenatherea)	■		
0	6	*Matricaria maritima* ssp. *inodora* (Chenopodio-Scleranthea)			—
		hgm3			
2—3	5	*Stellaria media* (Chenopodio-Scleranthea)	■	—	
2—3		*Verbena officinalis* (Plantaginetea)	—	—	—
3	6	*Eryngium planum* (Alopecurion pratensis)			—
		Mesophyta:			
		m1			
0	5	*Trifolium repens* (Molinio-Arrhenatherea)	■	■	
2—3	5	*Taraxacum officinale* (Molinio-Arrhenatherea)	■	—	—
2—3	5	*Centaurium erythraea* (Molinio-Arrhenatherea)	■	—	
2—4	4	*Rumex acetosa* (Molinio-Arrhenatherea)	■	—	—
2—3	6	*Centaurea pannonica* (Molinio-Arrhenatherea)		—	—
3—4	6	*Arctium lappa* (Plantaginetea)			—
0	3	*Convolvulus arvensis* (Chenopodio-Scleranthea)			■
		m2			
2—3		*Lolium perenne* (Plantaginetea)	■	■	■
0	6	*Trifolium pratense* (Molinio-Arrhenatherea)	■	■	■
0		*Verbascum blattaria* (Arrhenatherion)		—	—
3		*Solanum nigrum* (Chenopodio-Scleranthea)			—
		m3			
0	5	*Daucus carota* (Molinio-Arrhenatherea)	■	■	■
2—3	4	*Silene alba* (Chenopodio-Scleranthea)		■	■
0	3	*Ballota nigra* (Chenopodio-Scleranthea)			■
3		*Sisymbrium officinale* (Chenopodietea)		—	—
		Meso-xerophyta:			
		mx1			
2—3	5	*Cerastium fontanum* ssp. *triviale* (Mol.-Arrhenatherea)	■	—	■
2—4	6	*Medicago lupulina* (Molinio-Arrhenatherea)	■	—	■

F	W	Sub-association:	1	2	3
2—3	4	*Polygonum aviculare* (Chenopodio-Scleranthea)			
0	5	*Cichorium intybus* (Molinio-Arrhenatherea)			
2—3	5	*Silene vulgaris* (Molinio-Arrhenatherea)			
2		*Malva sylvestris* (Chenopodio-Scleranthea)			
2—3		*Lepidium ruderale* (Chenopodio-Scleranthea)			
2		*Xanthium spinosum* (Onopordion)			
		mx2			
0	4	*Lotus corniculatus* (Molinio-Arrhenatherea)			
2	3	*Poa angustifolia* (Festuco-Brometea)			
2—3		*Verbascum phlomoides* (Festuco-Bromea)			
3	4	*Plantago lanceolata* ssp. *sphaerostachya* (Festuco-Bromea)			
0	3	*Pimpinella saxifraga* (Festuco-Bromea)			
2	2	*Achillea collina* (Chenopodio-Scleranthea)			
1—2	3	*Coronilla varia* (Festuco-Brometea)			
1	2	*Eryngium campestre* (Chenopodio-Scleranthea)			
2—3	4	*Viola arvensis* (Secalietea)			
1—2		*Cuscuta epithymum* (Festuco-Brometea)			
		mx3			
2		*Portulaca oleracea* (Chenopodio-Scleranthea)			
1—2	3	*Erodium cicutarium* (Festuco-Bromea)			
2—3	4	*Erigeron canadensis* (Chenopodio-Scleranthea)			
2	3	*Fragaria viridis* (Festucetalia valesiacae)			
2—3	3	*Hypericum perforatum* (Festuco-Bromea)			
1—2	2	*Potentilla argentea* (Festuco-Bromea)			
2—3	3	*Carex praecox* (Festuco-Brometea)			
		Asteno-xerophyta:			
		ax1			
1—2	3	*Medicago varia* (Festuco-Brometea)			
2	3	*Cynodon dactylon* (Chenopodio-Scleranthea)			
2		*Eragrostis minor* (Polygonion avicularis)			
0		*Atriplex tatarica* (Chenopodio-Scleranthea)			

therum elatius has by far an outstanding value; since for this species, the Northern-North-Western dam-slope provided favourable living conditions from bioclimatic point of view.

2.2. *P.—A. arrhenatheretosum* (typicum) n. nov.

From the 3 subunits of the association, this species is the most wide-spread at the studied area, occupying the middle zone of the dam-slope. Compared to the previous sub-association, its environmental-biological situation changed to a significans degree, both in regard to the cenosystematic affiliation of their species and the phytomass production. The continual aridity of the environs reduced the competitivenest of the more fastidious species to the benefit of those which are droughtresistant. Therefore, the Molinio-Juncetea components, together with the less adaptive Molinio-Arrhenatherea and the Calistegion representatives were missing from their phytocenoses. Due to this the total covering quota of the Festuco-Bromea species is significant, apart from the certain species of the Molinio-Arrhenatherea having wider ecological amplitude.

Their characteristic species are the *Rumex acetosa, Daucus carota, Prunella vulgaris*. The further data are observable from Table 5.

Table 5. *Evaluation of the subunits of the Lolio-Plantaginetum majoris regarding species number and covering quota.*

	Species number			Covering quota		
	1	2	3	1	2	3
Alopecurion pratensis	.	1	1	.	3	0,5
Plantaginetea	3	4	4	31	34	26
Arrhenatherion	.	1	1	.	1	0,5
Mol.-Arrhenatherea	12	14	11	38	23	19
Agropyro-Rumicion	4	4	.	16	4	.
Onopordion	.	.	1	.	.	0,5
Chenopodietea	.	1	.	.	1	.
Polygonion avicularis	.	.	1	.	.	1
Chenopodio-Scleranthea	3	4	.	7	5	.
Secalietea	.	.	1	.	.	1
Festuco-Brometea	.	3	4	.	13	10
Festuco-Bromea	3	3	6	3	2	9
Festucetalia valesiacae	.	1	1	.	1	2

Hydroecology

It showed significant variation from the previous cenosystematic subunit even on the basis of its curve showing its moisture-demand, since the helo-hygro- and hygrophyton species were already missing. The hygro-mesophyta also evidenced an enormous reduction in quota. Nevertheless, as expected, here too, the mesophyton representatives were the dominating ones. Comparing the culmination points of the hydroecological curves regarding the three sub-associations, the highest value was observable in the case of the *m2* subunit. This is partly the inheritance of the period from the half-culture condition, since the *Medicago sativa* also joined to the *Arrhenatherum* being present with high values (Fig. 4).

As the consequence of the continuous aridity of the site conditions, both in regard to species number and total covering quota, the *mx1* subunit species of the meso-xerophyta category became frequent in this dam-slope zone.

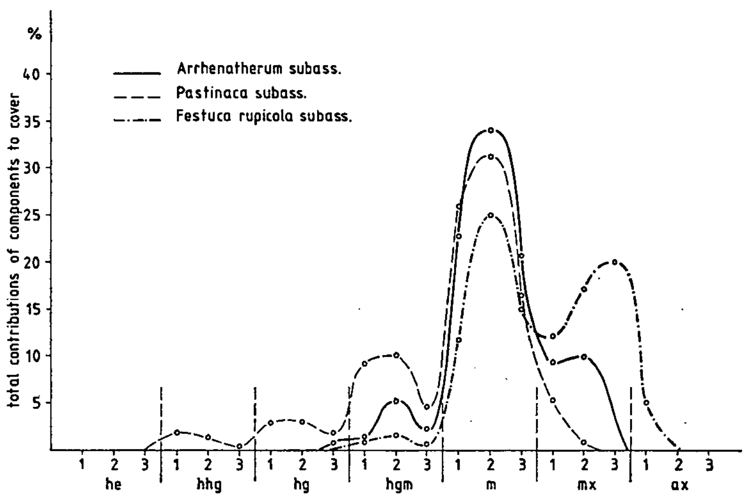

Fig. 4. The constructed comparative hydroecological curves of the three units of the association according to total covering quota.

2.3. *P.—A. festucetosum rupicolae* (n. nov.)

Despite the fact that such a dam-slope was chosen for study which directed at the water in North-Eastern-, Eastern, or South-Eastern position, drier environmental-biological relations developed at the dam-top zone, since the dammoisturing effect of the periodically appearing floods did not prevail at this zone. This explains why significant differences could be demonstrated compared to the zone of the plant stand found beneath (Table 4).

Hydroecology

Likewise, as it could be determined in the case of the typical stands, here too, those belonging to the helo-hygrophyta, hygrophyta category were missing and even the hygro-mesophyton species appeared only in blades. Analysing the mesophyta, no significant alteration could be demonstrated, neither in regard to those belonging to the *m1* or *m2* subunit — compared to the previous sub-associations. The greatest variation could be evidenced during the course of separating the species belonging to the meso-xerophyton category. Firstly the amount and covering quota of those belonging to the *mx3* subgroup increased. Further data are observable on Figure 4.

3. *Lolio—Plantaginetum majoris* (LINKOLA 21) BEGER 30
(Syn.: *Lolietum perennis* GAMS 27)

This species was formed in the lower zone of the outer side of the dam-slope, devoid of floods, mainly near settlements and water-guard houses. Its development was determined by two external factors; on one part, through the effectiveness of the favourable soil-moisture relations ensured by the Tisza water oozing through below the dam at the time of higher flood level, and on the other part on the effect of the grazing, treading and dunging of the small live stock reared by the population at the environs, as complex effect of zoogenic factor. Depending on the degree of effectiveness of these two external factors — to which further also joined, as for example, the physical and chemical composition of the soil — the species components of this grass stand may show significant variation. On this base, three association-units could be differentiated at this section of the dam.

3.1. *L.—P. plantaginetosum majoris* (n. nov.)

On the effect of enhanced treading of small live stock, such nitrophylic plant species became dominant, which are capable of accomodating against this influence, and are trailing on or adnating to the soil surface. Such are the *Plantago major Potentilla reptans, Trifolium repens, Medicago lupulina, Polygonum aviculare, Erodium cicutarium,* etc. The high value of the covering quota of the *Plantago major* demonstrable at places was reached by the fact that the species suppressed others within its environment by means of its effusing leaves.

Differential species: *Rorippa silvestris, Poa annua, Mentha pulegium.*

Cenological relations

The Molinio-Arrhenatherea components capable of accomodating to the local conditions, are the dominant species both regarding species number and total covering quota. The Plantaginetea and the joining Agropyro-Rumicion species have lower species number, but are of dominant character. The Chenopodio-Scleranthea and the Festuco-Bromea representatives have subordinate role (Table 6).

Hydroecology

Since the lower zone of the dam becomes damp periodically even at the protected side, certain species, like the *Rorippa sylvestris, Mentha pulegium, Ranunculus sardous, Potentilla reptans,* — belonging to the helo-hygrophyton and hygrophyton category, — may show more significant covering quota. The *Plantago major* of the *hgm1* subunit was nevertheless dominant.

Analysing the distribution of the species belonging to the certain categories and sub-groups, respectively, on the basis of their total covering quota, by drawing the obtained hydroecological curves, it could be seen that these species have four smaller-larger culmination points. The highest value, which at the same time is also the characteristic of the sub-association, was found in the case of the *hgm1* subunit. The values of the *m* category are still regarded as being subordinate (Fig. 3).

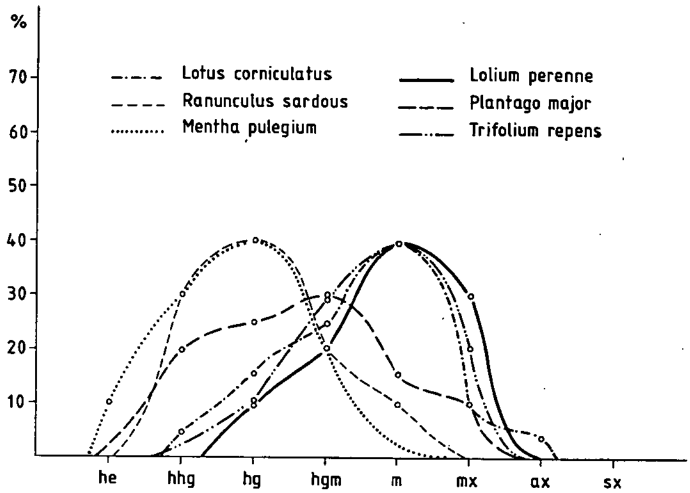

Fig.5. The comparative hydroecological curves of the characteristic species of the *Lolio-Plantaginetum.*

3.2. *L.—P. lolietosum perennis* (typicum) n. nov.

This species appeared at the lower section of the protected side of the dams at the Northern Lowland, when this zone was located somewhat farther from the inhabited areas than the previous; therefore the zoogenic effect showed a slight decrease. At the same time the effect of the soil moisture prevailed further on. It presumably developed from the grass stand of the previous association. The results of the analysis regarding their species combination refer to this.

Cenological relations

Even here, the Molinio-Arrhenatherea species are the dominant, at the same time, the Plantaginetea elements have leading role in respect to the total covering quota. Even so, the Festuco-Brometea species are still competitive under the environmental-biological circumstances manifested here, and their total covering quota is significant, as was experienced in the case of, e.g. the *Poa angustifolia.*

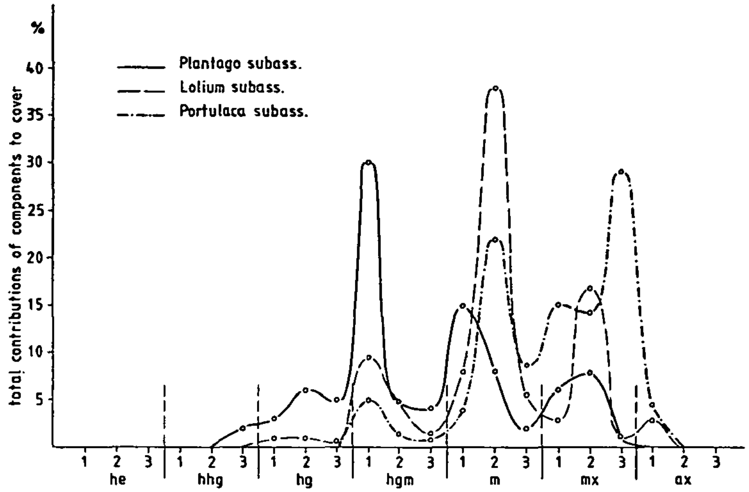

Fig. 6. Distribution according to total covering quota of the three subunits of the association.

Hydroecology

Compared to the previous sub-association, the highest values of the total covering quota were determined at the *hgm1* subunit; a decrease to 1/3 was observed in the case of this stand. Therefore, this can be regarded as a typically mesophyton association, since the culmination point of its hydroecological curve can be found at the *m2* (Fig. 6). This presented itself firstly from the dominating role of the *Lolium perenne*. However, depending on the rate at which the number of the species demanding moisture increased, a close to similar increase was found in the covering of the meso-xerophyta, first of all, in the case of the *mx2*-s. Nevertheless, a few representatives which could be regarded as being asteno-xerophyta were also detectable, firstly the consolidated hybrid, the *Medicago varia* of *ax1* nature, which became general at the sand-soils poor in lime-carbonate found at the Nyir in Northern Hungary.

3.3. *L.—P. portulacetosum oleraceae* (n. nov.)

At those areas of the Hungarian Northern Lowlands, where the dams are contiguous with chernozem-like sandy-soils, is the area where this sub-association developed at certain sections of the dam-slopes. Its development, however, is not only observable exclusively along the dams, since it can also be found the flood-plain pastures of higher relief.

Cenological relations

Their differential species determined during the course of the cenosystematic analysis were those from the Chenopodio-Scleranthea, like the *Portulaca oleracea* and the *Erigeron canadensis*.

Hydroecology

The site relations of this species are essentially drier than those of the previous sub-association. This is reflected by the distribution according to subunits of the species components within the certain categories. On the basis of the curve drawn regarding the total covering quota, it can well be seen that the hygrophyton representatives are completely missing; but minimal covering was also observed in the case of the hygro-mexophyta. From the mesophyta, the *Lolium perenne* belonging to the *m2* group also had a leading role here, due to its wide hydroecological adaptability. The highest peak of the curve was found at the line of the *mx3* subunit, firstly by means of the total covering of the *Portulaca oleracea* and the *Erigeron canadensis, Erodium cicutarium.* From the astenoxerophyton species the *ax1*-like *Medicago varia* did not show considerable expansion. In the case of more enhanced zoogenic utilization, however, the *Cynodon dactylon* also belonging to the *ax1* unit grew here at places and could also be regarded as facies component.

4. *Salvio nemorosae — Festucetum rupicolae* ZÓLYOMI 58 corr. SOÓ 64

This species appeared at the flood-free slopes of the dams along the Upper-Tisza in case the slope was of Southern- South-Western exposition. On the effect of enhanced and long-lasting insolation, both the bioclimate of the slope and the moisture supply of the soil showed significant variations, contrary to the similar relations of the opposite side. As the consequence of this, gradual transformation was observable regarding the grass stand sown earlier to prevent the damage in the erosion of the new dam; since the species components of this culture-grass stand, e.g. the *Arrhenatherum elatius, Dactylis glomerata, Poa pratensis, Bromus inermis, Medicago sativa,* etc. could not be competetive against the penetrating more drought-resistent plant species besides the environmental-biological relations developing at this area. This is how centuries ago, the cenoses of rather poor species composition, the *Salvio-Festucetum rupicolae tibiscense* ZÓLYOMI 58 developed; the speciesrelated to the hill-counttry and hechernozem inapl-grass of loes origin.

Cenological relations

During the course of the more thorough studying of this damslope zone, sub-associations and facies of differing species composition could also be differentiated in the case of this grass association.

4.1. *S.—F. festucetosum rupicolae* (typicum)

This species occupied the lower and at the same time wider zone of the dam-slope being of Southern-, South-Western exposition. This was no longer two-levelled, the sinuosity of the grass blades was missing and its stand was not always terminated. The variation was striking when comparing this species with the grass developing on the effect of the similar site relations found at the Hungarian Central and Lower Tisza region where this association is missing, and the various association-units of the *Cynodonto-Poëtum angustifoliae* are the wide-spread. The spontaneous settling and expansion of the *Festuca rupicola* may firstly be the result of the climatic effect of mountain character of the nearby highlands.

Cenological relations

The Festuco-Brómea are the most dominating species, both in regard to species number and covering quota. Therefore, the Molinio-Arrhenatherea elements are only represented by a few species. Their numerical distribution is demonstrated on Tables 7 and 8.

Table 7. *Salvio—Festucetum rupicolae.*
1. Daucus fac. 2. festucetosum rupicolae 3. Medicago varia fac. 4. poëtosum angustifoliae

F	W	Sub-association:	1	2	3	4
		Hygrophyton, Hygro-mesophyta: *hg3, hgm2, 3*				
3—4	8	*Stenactis annua* (Calystegion)				
0	8	*Rubus caesius* (Salicetea)				
4—5	8	*Rorippa austriaca* (Agropyro-Rumicion)				
		Mesophyta: *m1, 2*				
0	3	*Convolvulus arvensis* (Chenopodio-Scleranthea)				
0	4	*Cirsium arvense* (Chenopodio-Scleranthea)				
2—3	4	*Medicago sativa* (Festuco-Bromea)				
0	5	*Daucus carota* (Molinio-Arrhenatherea)				
2—3	4	*Tragopogon orientale* (Molinio-Arrhenatherea)				
2—3	4	*Silene alba* (Chenopodio-Scleranthea)				
3	4	*Setaria lutescens* (Agropyro-Rumicion)				
		Meso-xerophyta: *mx1*				
0	5	*Cichorium intybus* (Molinio-Arrhenatherea)				
		mx2				
2	3	*Poa angustifolia* (Festuco-Bromea)				
2—3	4	*Plantago lanceolata* (Festuco-Bromea)				
2	2	*Achillea collina* (Chenopodio-Scleranthea)				
2	3	*Nonea pulla* (Festucion rupicolae)				
		mx3				
2	1	*Festuca rupicola* (Festuco-Bromea)				
2—3	4	*Erigeron canadensis* (Chenopodio-Scleranthea)				
1—2	3	*Euphorbia cyparissias* (Festuco-Brometea)				
2—3	3	*Crepis rhoeadifolia* (Festuco-Brometea)				
2—3	1	*Hieracium pilosella* (Festuco-Bromea)				
1—2	2	*Potentilla argentea* (Festuco-Bromea)				
1—2	2	*Trifolium arvense* (Festuco-Bromea)				
2		*Tunica prolifera* (Festuco-Bromea)				
2	3	*Fragaria viridis* (Festucetalia valesiacae)				
		Asteno-xerophyta: *ax1, 3*				
1—2	3	*Medicago varia* (Festuco-Brometea)				
1	1	*Sedum sexangulare* (Festuco-Bromea)				
		Steno-xerophyton: *sx1*				
1	0	*Sedum acre* (Festuco—Bromea)				

Hydroecology

The majority of the species components of the *S.—F. festucetosum rupicolae* which can be regarded as being typical, can be grouped into the *mx3* subunit of the meso-xerophyton category. The culmination point of the hydroecological curve drawn for this species reached and even surpassed the value of 50%, respectively (Fig. 7). Regarding its total covering quota, it reached an extremely high peak — close to a value of 70% — at the *mx3* subunit line. At the same time, neither the presence of the mesophyton, nor that of the asteno-xerophyton can be regarded as considerable.

4.1.1. *S.—F. festucetosum Daucus* facies

From cenosystematic point of view, it could be determined that the *Daucus carota* having wide ecological adaptability expanded at places (Fig. 7).

4.2. *S.-F. poëtosum angustifoliae*

At the upper zone of the dam-slope prevented from floods the environmental-biological, firstly the soil-moisture supply, and the bioclimate relations, are more unfavourable than at the zone underneath.

Cenological relations

The differential species of the sub-association were composed of certain Festuco-Bromea representatives. Such are the *Medicago varia, Sedum sexangulare, S. acre.* Regarding the mass relations of the denominating *Poa angustifolia,* this species outrivaled the *Festuca rupicola.* Both belonged to the mentioned cenosystematic unit.

Table 8. *Evaluation of the four subunits of the association according to species number and covering quota.*

	Species number				Covering quota			
	1	7	3	4	1	2	3	4
Molinio-Arrhenatherea	2	2	3	2	16	7	3	4
Calystegion	1	.	.	.	1	.	.	.
Agropyro-Rumicion	2	.	.	1	2	.	.	3
Chenopodio-Scleranthea	4	4	4	5	15	16	14	16
Festucetalia valesiacae	.	1	.	.	.	1	.	.
Festuco-Brometea	.	1	1	3	.	5	15	12
Festuco-Bromea	4	8	12	8	81	41	60	65
Salicetea	1	.	.	.	1	.	.	.

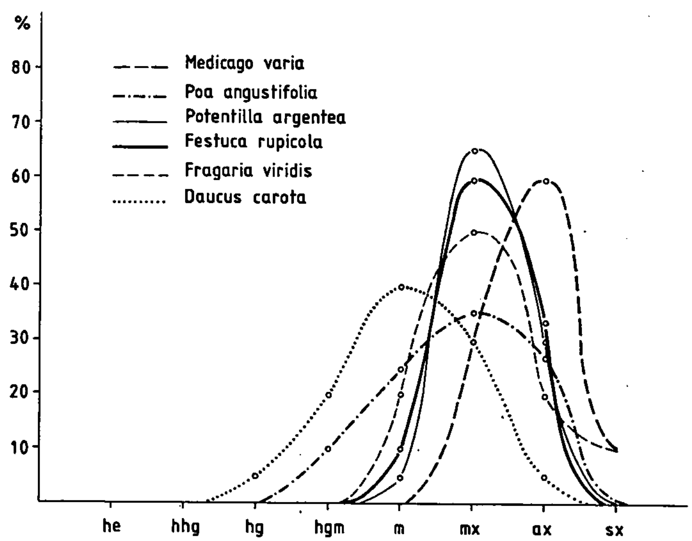

Fig. 7. The hydroecological curves of the more important six species of the *Salvio-Festucetum.*

Hydroecology

From the species components of the stand, the total covering quota of those belonging to the mesophyton category, was found to be similar to the values of the previous sub-association. The meso-xerophyta were found distributed on the *mx2* and *mx3* subunit lines. The *Poa angustifolia* had the leading role in the case of the *mx2* subunit, and the *Festuca rupicola* in the case of the *mx3*. Although reverse order would have been expected, the *Poa angustifolia* was found to have an extremely wide adaptability. This is also shown by its drawn hydroecological curve (Fig. 7), where the minimal points are found at the *hg* and *sx* categories. Division into at least two ecotypes would be reasonable on this base, since regarding the appearance of this species, it can be found just the same at the river-side marshy-meadows, as at the areas of dry quick ground. Further details are observable on Figure 8.

4.2.1. *F.-S. poëtosum angustifoliae Medicago varia* fac.

This facies-forming species appearing in masses formed a zone along the driest upper section (dam-top) of the damslope. Dam sections containing higher sand fractions are frequent at the areas of the Nyir in North-Eastern Hungary, at which region

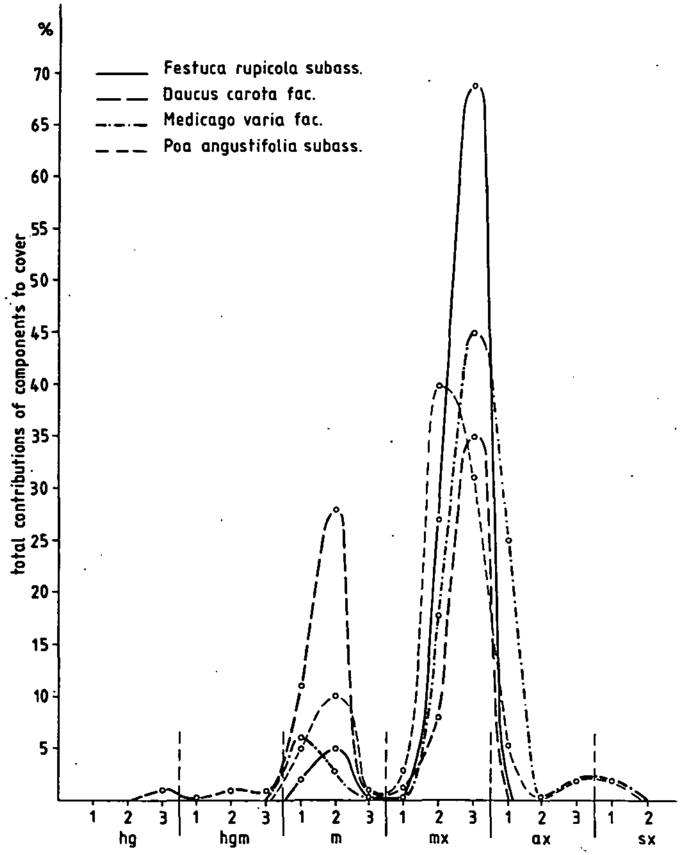

Fig. 8. Changes in moisture demand of the four subunits of the association on the basis of their total covering quota.

the representatives of this Festuco-Bromea species found favourable living conditions for themselves. The *Sedum sexangulare* and the *S. acre* belonging to the same ceno-systematic unit were also found in this ame stand.

Hydroecology

This facies-forming *Medicago varia* is such an asteno-xerophyton species which can be grouped into the *ax1* subunit, but may also show transition towards the *mx3* (Fig. 7). At the same time, in its grass stand — just the same as in the zone found below — certain deeply rooted species, like the *Convolvulus arvensis, Cirsium arvense, Tragopogon orientale, Silene alba,* and the feral *Medicago sativa* remaining after plantation even during the course of several decades, are also detectable in this cenosis. From the viewpoint of moisture demand, however, the leading role is still played by the *Festuca rupicol,* belonging to the *mx3* subunit.

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A Felső-Tisza menti árvédelmi töltések gyeptársulásainak hydroökológiája

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Kivonat

A terület védtöltésein a közel egy évszázaddal ezelőtt vetés útján kialakított gyepállományok nagymértékben megváltoztak. Zonális elrendeződésüket a gyakori de rövid ideig tartó árhullámok és a töltéslejtők expozíciója szabta meg. Az egyes állományok összetétele eltér a dél-tiszavölgyiekétől.

1. *Alopecuro-Arrhenatheretum* az északi-, északkeleti töltéslejtő alsó zónájában az ismétlődő árvizek hatására alakult ki. Uralkodók a helo-hygrophyton és hygrophyton képviselők.

2. *Pastinaco-Arrhenatheretum* a töltéslejtő felső zónájában három szubasszociációja volt elkülöníthető s a hygro-mesophyton kategória különböző alegységeibe tartozó fajok jelentkeztek.

3. *Lolio-Plantaginetum* a védtöltés nyugati-délnyugati árvizektől mentett alsó zónájában, fokozott zoogén hatásra alakult ki.

4. *Salvio-Festucetum rupicolae* a mentett töltéslejtő középső- és felső zónájában négy szubasszociációra volt különíthető. Fajkomponensei már meso-xerophyton képviselők voltak.

Гидроэкология травянистых сообществ защитных дамб вдоль верхнего течения Тисы

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Резюме

Состав сформировавшегося около ста лет назад путём посева травостоя на территории защитных дамб сильно изменился. Его зональное распределение определилось частыми, но краткими наводнениями и склоном дамб. Состав отдельных травостоев отличается от характерного для южно-тисайской долины.

1. Alopecuro-Arrhenatheretum сформировался в нижней зоне северного и северно-вос-

точного склона дамб под влиянием повторных наводнений. Преобладают гело-гидрофитонные и гидрофитонные представители.

2. Pastinaco-Arrhenatheretum выделялся в трёх субассоциациях в верхней зоне склона дамб и был представлен видами, относящимися к различным подразделениям гидро-мезофитной категории.

3. Lolio-Plantaginetum сформировался в нижней, защищённой от наводнений зоне западных и юго-западных склонов под усиленным зоогенным влиянием.

4. Salvio-Festucetum rupicolae можно было выделить в четырёх субассоциациях в защищённой средней и высшей зоне склонов. Компонентами видов являются уже мезо-ксерофитные представители.

Hidroekologija travnatih zajednica na nasipima gornjeg toka reke Tise

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Abstrakt

Travnate zajednice kultivisane na nasipima pre skoro jednog veka, značajno su se izmenile. Zonalni raspored je odredjen čestim i kratkotrajnim plavljenjima, kao i ekspozicijom stranica nasipa. Sastav pojedinih zajednica se razlikuje od onih u južnom toku reke.

1. Pod uticajem ponovljenih plavljenja *Alopecuro-Arrhenatheretum* zajednice su se razvile u donjoj zoni severo- i severoistočnih padina nasipa, sa dominacijom helo-hygrophyton i hygrophyton elemenata.

2. U gornjoj zoni padine nasipa moguće je razdvojiti tri subasocijacije *Pastinaco-Arrhenatheretum* zajednice, pri čemu u kategoriji hygro-mesophyton se javljaju vrste pripadnici različitih nižih jedinica.

3. *Lolio-Plantaginetum* zajenica je nastala pod zoogenim uticajem u donjoj neplavljenoj zoni nasipa, sa zapadnom i jugozapadnom ekspozicijom.

4. U središnjoj i gornjoj zoni neplavljenog dela nasipa izdvajaju se četiri subasocijacije *Salvio-Festucetum* zajednice, već sa meso-xerophyton vrstama.

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SEASONAL DYNAMICS OF THE SUCCESSION SERIES AT THE KÖRÖS FLOOD-PLAIN LEADING TO THE ASSOCIATION OF THE ECHINOCHLOO-HELEOCHLOETUM ALOPECUROIDIS (RAPCS 27) BODRK. 82.

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Studies were accomplished during the course of the years 1982—1983 on the phytocenosis succession series at the Körös flood-plain, leading to the development of a mud-plant stand in the residual borrow-pit of an earth mine, having various hydroecological demands and being inundationresistant. Depending on the duration of inundation at the various zones, the succession series of the following cenoses developed at the borrow-pit: *Alopecurus pratensis — Poa trivialis — Potentilla reptans-Xanthium italicum — Eleocharis palustris — Agrostis stolonifera-Xanthium italicum — Carex gracilis — Heleochloa alopecuroides.*

The representatives of *Carex gracilis, Eleocharis palustris, Xanthium italicum, Agrostis stolonifera* and *Heleochloa alopecuroides* were selected for evaluation in the constructed co-ordinate system along the straight lines intersecting the certain mosaic complexes. To elucidate the hydroecological relations of the various phytocenoses as well as the physical and chemical erlations of their soil, segment disclosures and laboratory studies were performed according to stands. On the basis of the evaluation of the succession series, tight relationship could be determined between the Heleochloa alopecuroides stands and the Bidention associationgroup. Since in the root-zone of their soils only slight — and at the same time diluted sodium salt accumulation was demonstrable, their linkage to the Cypero-Spergularion SLAVNIĆ 48 is not probable.

Introduction

The phytocenological and environmental-biological investigations on the mud-plant associations can be held as being wide-spread both in Hungarian and European relations. Studies in this concern have been reported from the Saxon territories by LIBBERT (1930), by UHLING (1939), by POLI and TÜXEN (1960), by HORVATIC (1931) from Kroatia and Slavonia; a comprehensive study was provided by KLIKA (1935) and later by HEJNY (1962). The essays on mud-plant associations written by LOHMEYER (1950), VICHEREK (1962), were followed in the seventies by GUTTE (1972), HEINRICH (1973), HILBIG and JAGE (1972), JAGE (1972), as well as MARKOVIC (1975). Regarding Europe, the summaries and critical evaluations of these associations were provided by PIETSCH (1963, 1966—1967) and PIETSCH and MÜLLER—STOLL (1968).

The complex environmental-biological evaluation of these is known from the basic studies by ELLENBERG (1952).

The publications by UBRIZSY (1948) and BODROGKÖZY (1958) deal with their stands occurring in Hungary, in respect to the mud vegetation of the culture areas. The published data (TÍMÁR 1950, TÍMÁR—BODROGKÖZY 1969, BODROGKÖZY 1982) on the results of studies carried out at the river beds and backwater banks of the Tisza-valley are those which stand the closest to the present topic.

In environmental-biological relations the TWR numbers determined by ZÓLYOMI et *al.* present the basis for the grouping of the various species into units. Their classification according to hydroecological units has also been performed, the details of which have been published during the course of the processing of the Mártély Environment Protection Area (BODROGKÖZY 1982).

The cenosystematic summary and evaluation respectively, of the mud-plant associations (Isoeto—Nanojuncetea) occurring in Hungary has been accomplished by PIETSCH (1973).

Materials and Methods

The possibility and suitable area respectively, for studying the development, course of succession and seasonal dynamics of the *Echinochloo-Heleochloetum alopecuroidis,* as mud-plant association, was found along the Körös, one of the affluents of the Tisza river. Namely, a 50 m long, 10 m wide and 2,20 m deep borrow-pit remained behind many decades ago from earth extraction at the left side of the river flood-plain situated 1 km from the barrage at Békésszentandrás. The grade differences developed due to the progressive alluvial deposit seemed suitable for performing these studies (Fig. 1), since as the consequence of the barrage functioning, the water level of the dip, and together with this, also the underground water level of the Körös flood-plain showed strong fluctuation. At the time of the rise of the river, there is also a simultaneous increase in the water level of the borrow-pit, therefore it is a most frequent phenomenon that their common water surfaces develop at the flood-plain. Nevertheless, the decrease in the water level of the Körös is not followed by the rapid lowering of the water level at the dip. Therefore, even a variation of 4—5 m in water surface may develop between the two water levels.

The inundation of various periods and duration developing after the subsidence, results in the development of vegetation zones having different species compositions. The mosaic system of the cenosis-complexes reflecting the various environmental-biological, and first of all, the hydroecological relations may also develop within various zones due to the differing smaller and durable inundations. By studying these, knowledge could be gained on the environment, species composition and succession-course of the *Echinochloo-Heleochloetum alopecuroidis,* along the Körös. During the course of investigations on the various vegetation zones at the dip allocated for studying, soil profiles were also explored parallel with the preparation of phytocenological pictures. During the course of the laboratory analysis of the collected soil samples (BALÁZS, DÉKÁNY and PATZKÓ) the soil granule fractions were also determined by hydrometric method. The organic matter content was measured with the help of dichromatic method and the hy value was calculated in air space with determined vapour content with the method of K. SIK. The calcium carbonate, pH and total salt contents were also determined with potentio-metric methods.

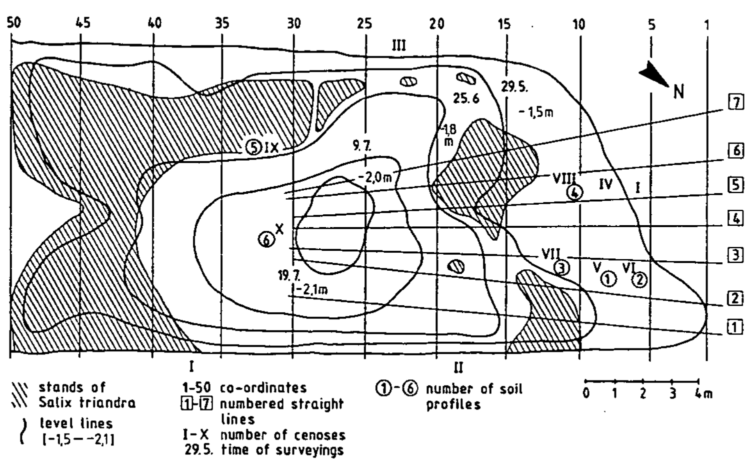


Fig. 1. Map of the studied Körös flood-plain borrow-pit residue, showing the designated co-ordinate system and the study site.

The percental distribution of the hydroecological characteristics of the various phytocenoses according to their areal quota could be determined after drawing the hydroecological graphs of the various species components (Bodrogközy 1982). The results of the soil- and hydroecological studies regarding the various plant stands are demonstrated on three-dimensional diagrams, for the sake of better reviewing and comparison.

On the constructed phytocenological tables the species were grouped in the sequence of their affiliation according to hydroecological categories. Apart from this, the F values appearing in the work of Soó as well as the W values of Zólyomi et al. were also presented. The various cenoses were labelled with Roman numbers from I—X., which can also be found on the sketch of the vegetation map.

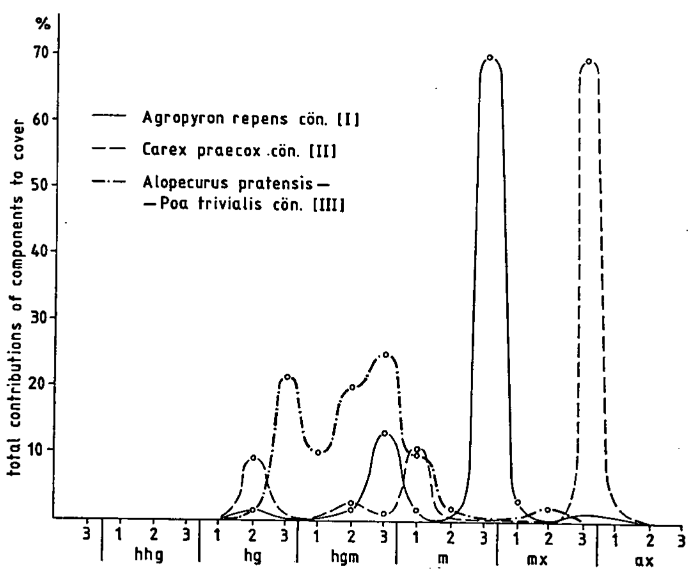
The different cenoses at the studied areas form mosaic complexes in compliance with the environmental differing effects, which are characterized by the continuity of the inundation of the various species components. These complexes were intersected by 7 straight lines (Fig. 1), on which the curves of the various inundation values are demonstrated. The inundation values are not co-ordinated to the complete intersection, but only to its focus. The co-ordinates of these can be found on the upper part of the map sketch, and are illustrated on the abscissa in the case of the graphs. In such manner, curves were obtained which can easily be interpreted and are descriptive.

Detailed evaluation

1. The environs of the studied area

The environment of the phytocenoses forming the zones of the borrow-pit selected for study may serve for the controlling of their association- and environmentalbiological relations. A discontinued tillage is located South-East from the area, directly at the border of the dip. The strongly devastated cenoses of the *Agropyron repens* (I) and the *Carex praecox* (II) are situated here. Several representatives of the Agropyro-Rumicion and Calystegion can be found among their species components (Table 1).

From hydroecological point of view, the analysis of the No. I. cenosis evidenced a 70% total covering quota for the mesophyton — in particular, the species from the



Fib. 2. Comparative hydroecological curves of the phytocenoses circumscribing the dip.

Table 1. *Cenoses of the Agropyron repens (I) and the Carex praecox (II)*

Water demand F	Water demand W	Hydroecological character	species	Character Species	Cenosis: I	II
				Total covering:	100	100
				Area (m²):	6	4
			Helo-hygrophyton:			
4—5	9	*hhg1*	*Lycopus europaeus*	Phragmitetea	0,5—1%	0,5—1%
			Hygrophyta:			
3—4		*hg1*	*Glycyrrhiza echinata*	Calystegion	0,5—1%	0,5—1%
4—5	8	*hg2*	*Ranunculus repens*	Agr.-Rumicion	0,5—1%	1—5%
3—4	7	*hg2*	*Tanacetum vulgare*	Calystegion	0,5—1%	1—5%
3		*hg2*	*Rorippa sylvestris*	Agr.-Rumicion	0,5—1%	1—5%
			Hygro-mesophyta:			
3—5	8	*hgm2*	*Rubus caesius*	Salicetea	25—50%	
3—4		*hgm2*	*Amorpha fruticosa*		1—5%	1—5%
3	4	*hgm3*	*Aristolochia clematitis*	Calystegion	25—50%	0,5—1%
2—3	5	*hgm3*	*Rumex crispus*	Agr.-Rumicion	0,5—1%	
			Mesophyta:			
0	4	*m1*	*Cirsium arvense*	Chen.-Scleranthea	1—5%	25—50%
2—3	3	*m3*	*Agropyron repens*	Agr.-Rumicion	50—100%	0,5—1%
			Meso-xerophyton, Asteno-xerophyton:			
2—3	3	*mx3*	*Carex praecox*	Festuco-Bromea	0,5—1%	50—100%
2	2	*ax1*	*Festuca pseudovina*	Festucion pseudov.	0,5—1%	25—50%

symbols: D-value
50—100%
25—50%
5—25%
1—5%
0,5—1%

(The symbols apply to table 1—5)

m3 category unit — on the plots taken on May 28, 1983. Similarly high values were detected from the No. II. cenosis; from here, on the line of the *mx3* subunit of the meso-xerophyton category (Fig. 2).

The Western- and South-Western border of the dip was found to be covered by the *Alopecurus pratensis — Poa trivialis* cenosis. Its soil- and relief relations respectively, are closely similar to the previous, nevertheless, the less termophilic species have become dominant. The cause of this is the *Salix alba — Populus nigra* gallery-forst situated nearby, with a tremination of 75%. Its shading effect has evidently resulted more favourable hygroecological relations. Regarding the total covering quota of the species of this cenosis per category, great difference was observed compared to the No. I. and II. cenoses. Its drawn curve shows two significant maximums: on the *hgm3* line within the hydromesophyton category, and on the *hg3* line within the hygrophyton, respectively (Fig. 2). The Molinietalia and Molinio-Arrhenatherea representatives are dominant from cenosystematic point of view (Table 2).

The regular succession studies were started on May 28, 1983. By this time, the decrease in water level at the borrow-pit made possible the development of the *Potentilla reptans — Xanthium italicum, Eleocharis palustris, Carex gracilis, Agrostis stolonifera — Xanthium italicum* cenoses.

Table 2. *Cenoses of the Alopecurus pratensis — Poa trivialis (III)*

Water demand F	Water demand W	Hydroeco-logical character	Species	Character species	Cenosis: Total cove-ring: Area (m²):	III 100% 10
			Hydato-helophyton: Helo-hygrophyton:			
3—4	10	*hhe2*	*Typhoides arundinacea*	Phragmitetea		
3	8	*hhg3*	*Agrostis stolonifera*	Agr.-Rumicion		
			Hygrophyta:			
3—4	7	*hg1*	*Carex hirta*	Mol.-Arrhenatherea		
4—5	8	*hg1*	*Symphytum officinale*	Molinietalia		
3—4		*hg1*	*Glycyrrhiza echinata*	Calystegion		
3—4	6	*hg2*	*Potentilla reptans*	Agr.-Rumicion		
3—4	9	*hg3*	*Poa trivialis*	Mol.-Arrhenatherea		
3—4	8	*hg3*	*Thalictrum lucidum*	Molinietalia		
			Hygro-mesophyta; Mesophyton:			
3	5	*hgm1*	*Alopecurus pratensis*	Mol.-Arrhenatherea		
4	5	*hgm1*	*Althaea officinalis*	Agrostion		
3—5	8	*hgm2*	*Rubus caesius*	Salicetea		
3	4	*hgm3*	*Aristolochia clematitis*	Calystegion		
3—4		*hgm3*	*Amorpha fruticosa*			
2—3	3	*m3*	*Agropyron repens*	Agr.-Rumicion		

Table 3. *Cenosis of the Potentilla reptans — Xanthium italicum (IV)*

Water demand F	Water demand W	Hydroeco-logical character	Species	Character species:	Cenosis Total covering: Area (m²)	V 100% 6
			Helophyton, Helo-hygrophyton:			
4—5	9	*he3*	*Lycopus europaeus*	Phragmitetea		
2—3	8	*hhg3*	*Agrostis stolonifera*	Agr.Rumicion		
			Hygrophyta:			
3—4	8	*hg1*	*Symphytum officinale*	Molinietalia		
2—3	6	*hg2*	*Potentilla reptans*	Agr.-Rumicion		
3—4		*hg2*	*Rorippa sylvestris*	Agr.-Rumicion		
			Hygro-mesophyta:			
3—4	5	*hgm1*	*Mentha arvensis*	Molinietalia		
3—4		*hgm1*	*Xanthium italicum*	Bidentetea		
3	7	*hgm1*	*Plantago major*	Plantaginetea		
2—3		*hgm2*	*Amorpha fruticosa*			
4	4	*hgm3*	*Aristolochia clematitis*	Calystegion		
			Mesophyton:			
2	3	*m3*	*Agropyron repens*	Agr.-Rumicion		

It can be seen from Figure 3 that the water still covers the major part of the *Salix triandra* zone. At the area becoming dry 1—1 zone standing of the *Carex gracilis* or *Eleocharis palustris* cenosis can be found. The zones of the *Carex gracilis* and the *Eleocharis palustris* cenoses near the water show coincidence; one or the other plant species occurs with prominent covering. The first straight line shows that the *Carex gracilis* cenoses form two zones. The *Xanthium italicum* and the *Agrostis stolonifera* do not form zones, their covering values do not have any pronounced maximum points; these values are similar to each other.

Potentilla reptans — Xanthium italicum cenosis (IV)

Its transitional stand developing at the North- North-Western section of the area could be found in deeper location than the surrounding relief, but it was only exposed to a more prolonged water covering for short period. However, during the norming hours, this stand is exposed to more enhanced isolation. On the effect of these environmental conditions, in its grass-plot, those of *hg2* character from the hygrophyton representatives and the *Potentilla reptans* belonging to the Agropyro-Rumicion were dominating. Nevertheless, at the same time, the number of the hygro-mesophyton species components was also significant (Table 3).

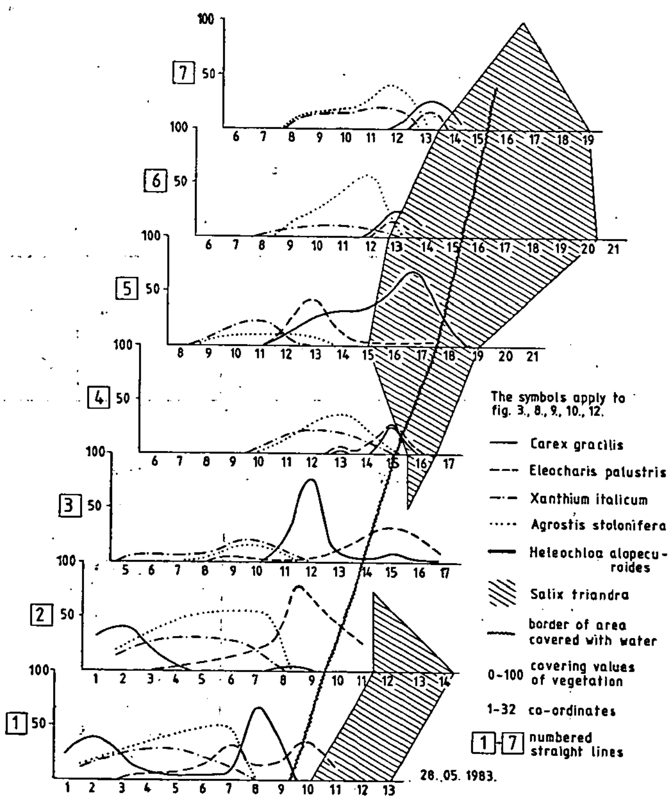


Fig. 3. Percental changes of the mosaic-complex-like covering of the selected species within the designated co-ordinates (May 28, 1983).

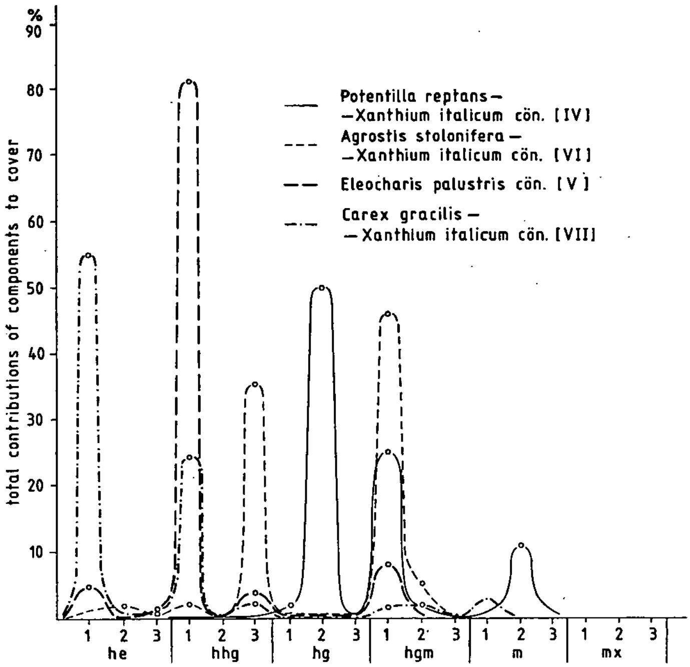


Fig. 4. Comparative hydroecological diagram of the four cenoses.

(V) *Eleocharis palustris* cenosis

The previous cenosis was followed by a section of more wider relief, which was in average about 1,5 m deeper than the environs of the borrow-pit. Even within the zone itself, smaller-larger relief differences appeared. Here, the smaller dips are also filled with stagnant water for longer periods, since their soil is permeable to water in a less degree. Therefore, the *Eleocharis palustris* cenosis developed here, belonging to the helo-hygrophyton category.

Cenological relations:

The species components of the stand belong to the *hhg1* subgroup, and represent a transitional character towards the *he3*-s. Nevertheless, certain perennial species — although with subordinate role — may also appear in their grass-plot, like the *Lythrum salicaria, Lycopus europaeus, Agrostis stolonifera,* which also are the members of the hhg category. The *Xanthium italicum* — the representative of the Bidentetea from the hygro-mesophyton category — also attains place for itself here, due to its being more agressive and having more enhanced adaptability. Concerning the affiliation of their stand, evaluating the total covering quota of their species, they have by far dominating role on the *hhg* 1 line (Fig. 4., Table 4).

Soil relations:

The soil segment of the cenosis originating from the place shown on the map of Figure 1 is found to be the most bound in the root zone from the viewpoint of phy-

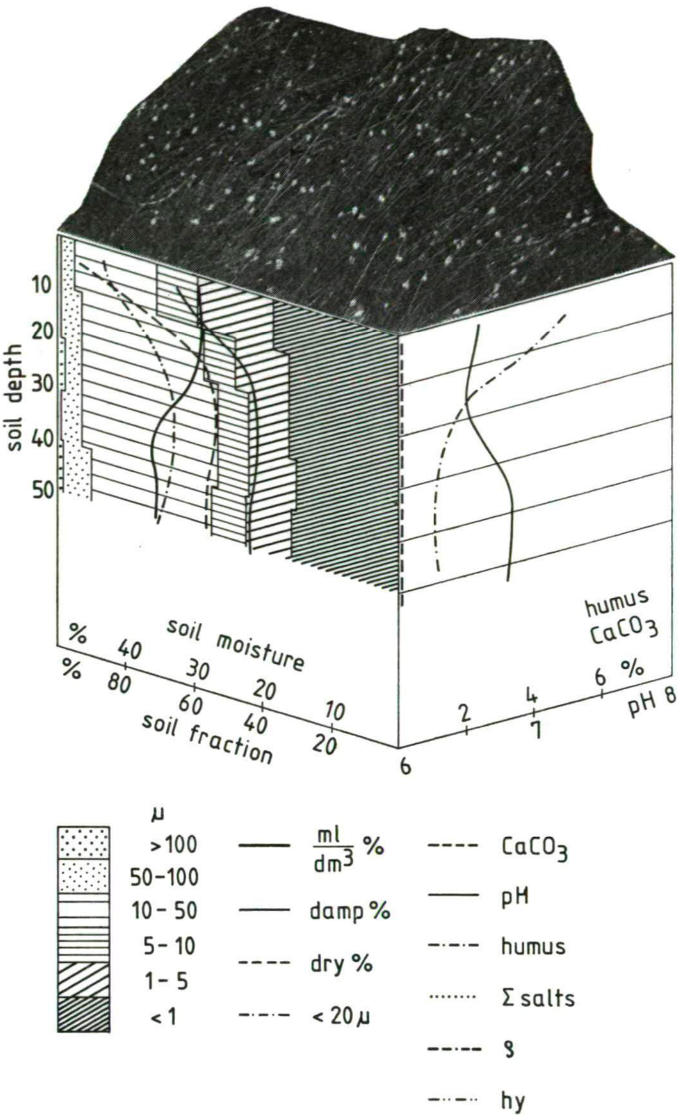


Fig. 5. The soil-ecological relations of the *Eleocharis palustris* stand (May 28, 1983).

sical composition, as shall also be experienced in the case of the cenoses to follow. This is referred to by the percental distribution ratio of the clay and mud fraction, compared to the sand fraction. The difficulty of penetration into the lower soil layers of the periodical water covering the surface can be attributed to this. Its values expressing hydrolytic acidity are balanced. Its organic matter content shows steady decrease towards the lower layers, hidden humus layer could not be determined. Further details are observable on Figure 5.

Agrostis stolonifera — Xanthium italicum cenosis (VI)

The next stand showing mosaic-like development could be found in an area having a somewhat more abrupt slope than the previous one, thus in environmental-ecological respect, it differs from the species components of the *Eleocharis palustris* cenosis.

Table 4. *Cenoses of the Eleocharis palustris (V), Agrostis stolonifera — Xanthium italicum (VI) and Carex gracilis (VII)*

Water demand		Hydroeco-logical character	Species	Character species	Cenosis: Total covering % Area (m²)	V	VI	VII
F	W					98 5	100 10	90 5
			Helophyta:					
4	10	*he1*	*Carex gracilis*	Caricion gracilis				
3—4	9	*he2*	*Lysimachia vulgaris*	Phragmitetea				
4—5	9	*he3*	*Lycopus exaltatus*	Phragmitetea				
			Helo-hygrophyta:					
4—5	10	*hhg1*	*Eleocharis palustris*	Mol.-Juncetea				
4	9	*hhg1*	*Lythrum salicaria*	Mol.-Juncetea				
4—5	9	*hhg1*	*Lycopus europaeus*	Phragmitetea				
3	8	*hhg3*	*Agrostis stlonifera*	Agr.-Rumicion				
3—4	9	*hhg3*	*Bidens tripartita*	Bidentetea				
4	8	*hhg3*	*Lythrum virgatum*	Alopecurion				
4—5	10	*hhg3*	*Iris pseudacorus*	Phragmitetea				
4	9	*hhg3*	*Juncus compressus*	Agrostion				
			Hygrophyta:					
4—5	8	*hg1*	*Symphytum officinale*	Molinietalia				
3—4	6	*hg2*	*Potentilla reptans*	Agr.-Rumicion				
3		*hg2*	*Rorippa sylvestris*	Agr.-Rumicion				
			Hygro-Mesophyta:					
3		*hgm1*	*Xanthium italicum*	Bidentetea				
3—4		*hgm1*	*Mentha arvensis*	Molinietalia				
2—3	7	*hgm1*	*Plantago major*	Plantaginetea				
0	8	*hgm2*	*Rubus caesius*	Salicetea				
3—4		*hgm2*	*Amorpha fruticosa*					
			Mesophyta:					
0	4	*m1*	*Cirsium arvense*	Chen.—Scle-ranthea				
3—4	6	*m1*	*Inula britannica*	Plantaginetea				

Cenological relations:

Regarding the total covering quota of the species of the stand, two more significant culmination points from the hygro-mesophyton to the helohygrophyton category can be observed on the drawn curve (Fig. 4).

Soil relations:

The study results are shown on the diagram of the 2nd explored segment. Although being similar to the previous structures, here the harmful salts are demons-

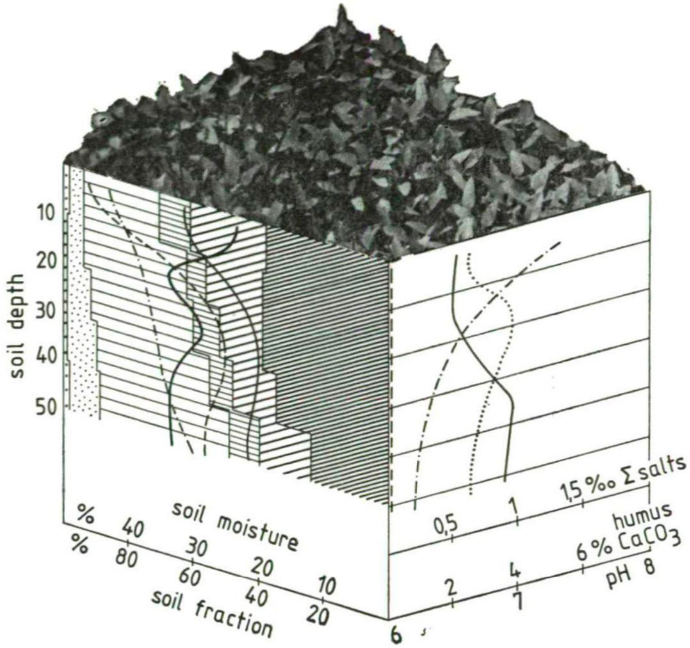


Fig. 6. The complex-mosaic soil profile of the *Agrostis-Xanthium.*

irable, coming close to 0,10% in the lower soil layers. On its effect, however, since tt hardly reached the lower limit of the salinity grade, no halophyton species were found among the species components (Fig. 6., Table 4).

Carex gracilis cenosis (VII)

At the same relief area, but in slightly greater patches the stagmant water exerted its effect for a shorter period. Due to this, the dominating species were the *Carex gracilis* stands and not the one year old species. Since no significant changes were observed in the soil segment, — neither during the course of physical, nor chemical analysis, — the short period of water covering presumably showed favourable effect on the development of this sedgy stand (Fig. 7., Table 4).

Figure 8 demonstrates the conditions of 25th June. The changes in covering of the representative plant species can also be seen from the Figure (Fig. 8). Within the period of 1 month, the water level decreased to such an extent that the complete *Salix triandra* zone came to dry surface. Newer *Eleocharis palustris* or *Carex gracilis* zones developed within the *Salix* zone. From outside, the *Xanthium italicum* and the *Agrostis stolonifera* continuously expanded inwards, but these cannot be found within the *Salix* zone at the timepoint of plotting.

The data of the next registration was 9th July.

Essential changes: The *Xanthium italicum* appears within the *Salix triandra* zone, however, the *Agrostis stolonifera* cannot be found within. As observable on the straight line of the third registration, it is not the *Salix triandra* zone which hinders the expansion of the *Agrostis stolonifera.* In the case of the outer *Carex* and *Eleocharis*

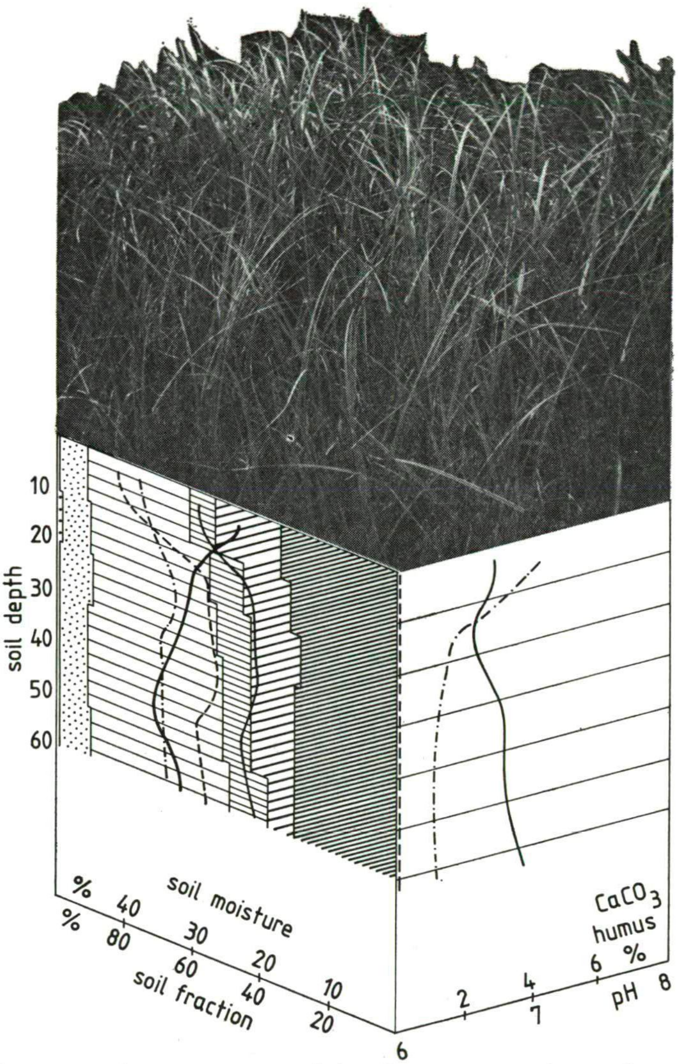


Fig. 7. The soil segment characteristics of the *Carex gracilis* cenosis (VII).

zones, a strong decrease in covering could be observed, their place being occupied by the *Agrostis stolonifera* and *Xanthium italicum* stands.

Figure 10 illustrates the central part of the studied area on July 19, 1983. Water has only remained at the deepest points. The *Heleochloa alopecuroides* shows mass germination, and the *Xanthium italicum* shows continuous expansion inwards. *Agrostis stolonifera* are still not observable within the inner areas (Fig. 10).

Figure 11 demonstrates the part of the area falling between the 30—42 co-ordinates. The photograph was taken on July 19, 1983.

By the middle of August, the vegetation occupies the complete study area. The last plotting was taken on 10th August, 1983 (Fig. 12). The studies carried out

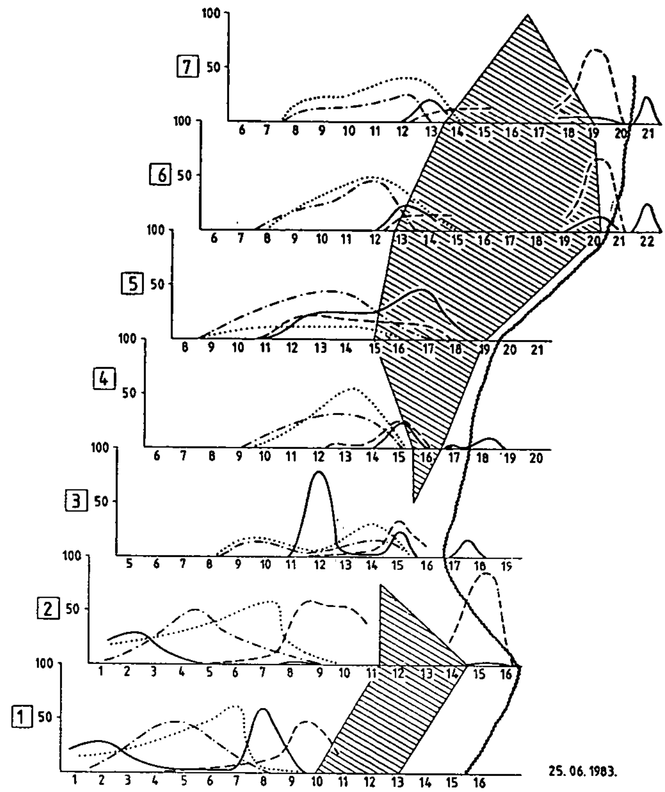


Fig. 8. The situation of the species components forming the mosaic complexes (June 25, 1983).

at later time-points did not show any essential changes in the composition of the phytocenoses. The phenomenon could be observed that pure *Heleochloa alopecuroides* stands developed at the deepest parts of the area. The expansion of the *Xanthium italicum* became slow inwards. The inner *Eleocharis* cenoses also became disorganized.

The *Xanthium italicum* even penetrated into the inner *Carex gracilis* zones. From the outer species, those were found to be the most stable, which originally possessed the slightest diversity. No amalgamation could still be detected in the case of the *Agrostis stolonifera* and the *Heleochloa alopecuroides.*

Conclusions regarding the phytocenological and hydroecological relations at the end of the vegetation period could be drawn from the studies carried out on November 5, 1982.

Agrostis stolonifera — Xanthium italicum cenosis (VIII)

The cenosis-complex labelled No. VIII. can be found at the −1,5 m relief somewhat further from those labelled Nos. V., VI. and VII. Their situation is the opposite here, contrary to the No. VI. cenosis-complex, where the culmination point of the hydroecological curve regarding the total covering quota of the *hgm1* species components was higher than those of the *hhg3.* The species being more sensitive against the covering by water for long duration — like the *Carex gracilis, Lysimachia vulgaris,* only had subordinate roles (Table 5, Fig. 13).

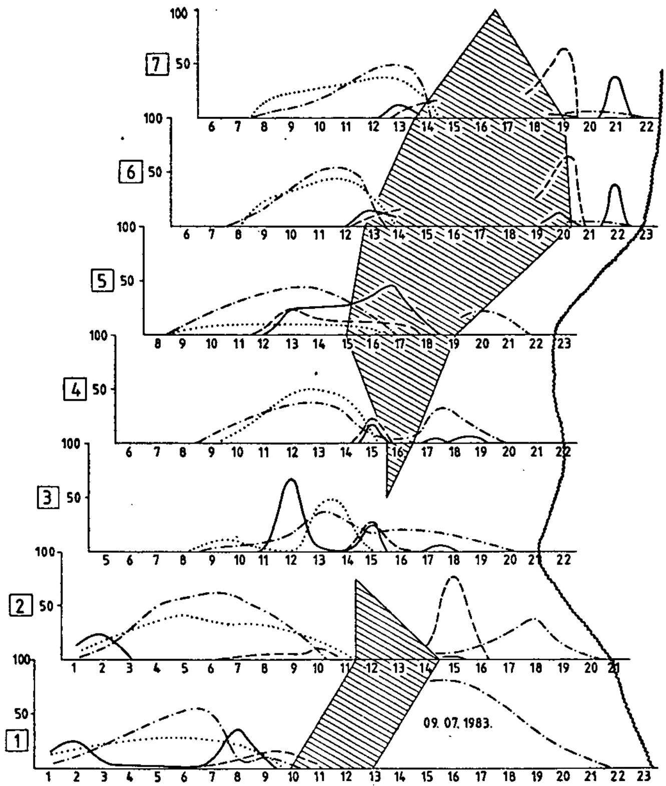


Fig. 9. The situation of the species components on July 9, 1983.

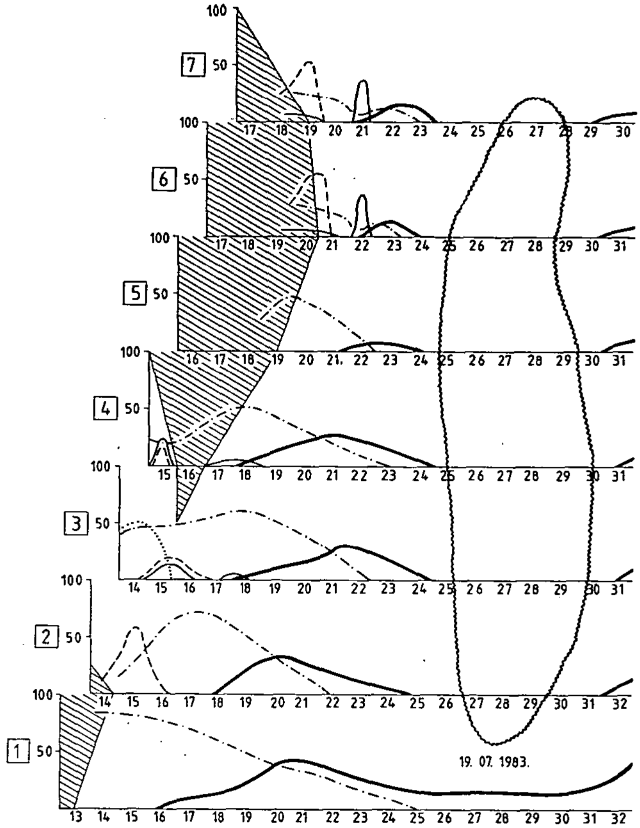


Fig. 10. Ten days later (July 19. 1983).

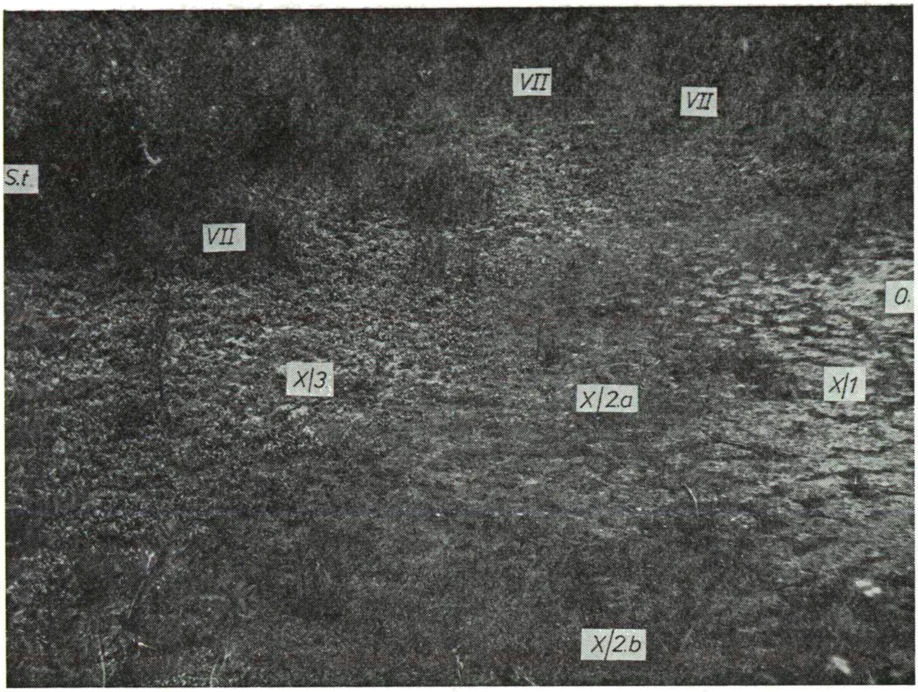


Fig. 11. Zonation system of the development of *Echinochloo-Heleochloetum alopecuroidis*
0 area still covered with water
X/1 initial stage of the appearance of the stand
X/2*a* the developed mud-grass
X/2*b* residue of *Xanthium italicum* penetrating in the earlier year into the Heleochloa alopecuroides cenosis
X/3 the boundary of this year's penetration of *Xanthium italicum*
VII complex of *Carex gracilis* cenosis
S. t. *Salix triandra* stand

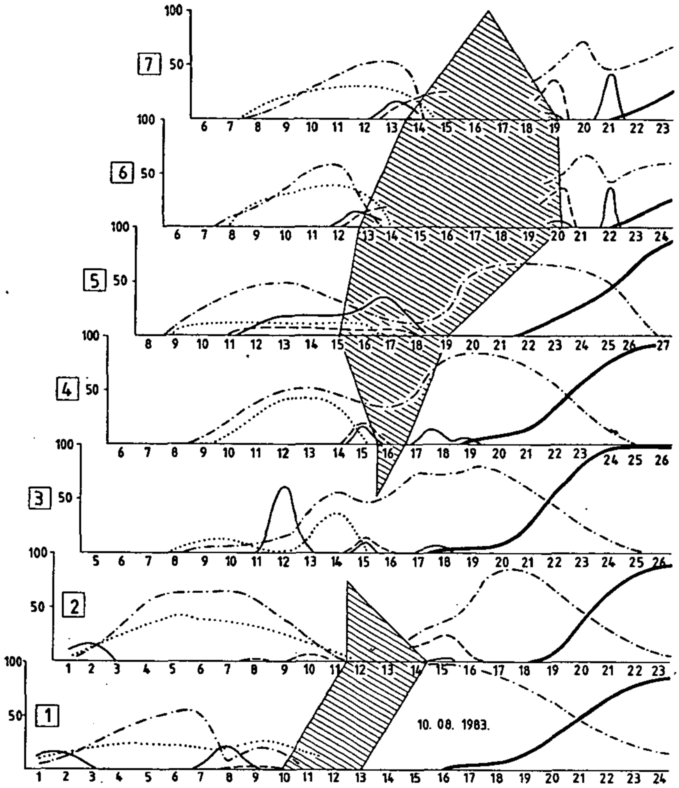


Fig. 12. Comparative percental values of the covering relations concerning the time-point August 10 1983.

Table 5. *Cenoses of the Agrostis stolonifera — Xanthium italicum (VIII, IX) and Heleochloa alopecuroides (X)*

Water demand F	Water demand W	Hydroeco-logical character	Species	Character species	Cenosis	VIII	IX	X
					Total covering	95	100	100
					Area (m²)	12	12	16
					Soil segment	4	5	6
			Helophyta:					
4	10	*he1*	*Carex gracilis*	Magnocaricion				
3—4	9	*he2*	*Lysimachia vulgaris*	Phragmitetea				
4—5	9	*he3*	*Lycopus exaltatus*	Phragmitetea				
			Helo-hygrophyta:					
4	9	*hhg1*	*Lythrum salicaria*	Mol.-Juncetea				
4—5	10	*hhg1*	*Eleocharis palustris*	Mol.-Juncetea				
3	8	*hhg3*	*Agrostis stolonifera*	Agr.-Rumicion				
2—4		*hhg3*	*Heleochloa alopecuroides*	Cyperio-Sperg.				
4	9	*hhg3*	*Juncus compressus*	Agrostion				
3—4	9	*hhg3*	*Bidens tripartita*	Bidentetea				
			Hygrophyta:					
3—4		*hg1*	*Glycyrrhiza echinata*	Calysregion				
3—4	6	*hg2*	*Potentilla reptans*	Agr.-Rumicion				
			Hygro-mesophyta:					
3		*hgm1*	*Xanthium italicum*	Bidentetea				
2—3	7	*hgm1*	*Plantago major*	Plantaginetea				
3—4		*hgm1*	*Mentha arvensis*	Molinietalia				
3—4		*hgm2*	*Amorpha fruticosa*					
			Mesophyta:					
2—3	3	*m3*	*Agropyron repens*	Agr.-Rumicion				

Soil relations:

From soil-physical point of view, the looser structure of the zone segment referred to its mosaic-complex-like arrangement. This could be concluded from the dominating role of the mud fraction and by the rise in the quota of sand. The moisture content was found to be essentially lower than the data measured in the Spring interval. Although harmful salts were also demonstrable here, they still did not reach the lower limit of the salinity degree. However, chalk concretions were detectable in the lower layers. The further data are demonstrated on Figure 14.

The No. 5. soil segment showed slight variation, where the boundary of covering of the *Salix triandra* was observable. Compared to the previous, higher moisture content was characteristic here. This was accompanied by the higher organic matter content demonstrable also in the lower soil layers. Although the percental values of the sodium salts reached a value of 0,10% here, it showed no effect on the species composition of the *Agrostio-Xanthietum* cenosis (IX). Nevertheless, the *Heleochloa alopecuroides* of *hhg3* nature was observable here (Table 5). The helophyton species did not show any changes.

Cenological relations:

The total covering quota of the species of this cenosis could be regarded close to similar to those of the No. VIII. cenosis (Fig. 13., Table 5).

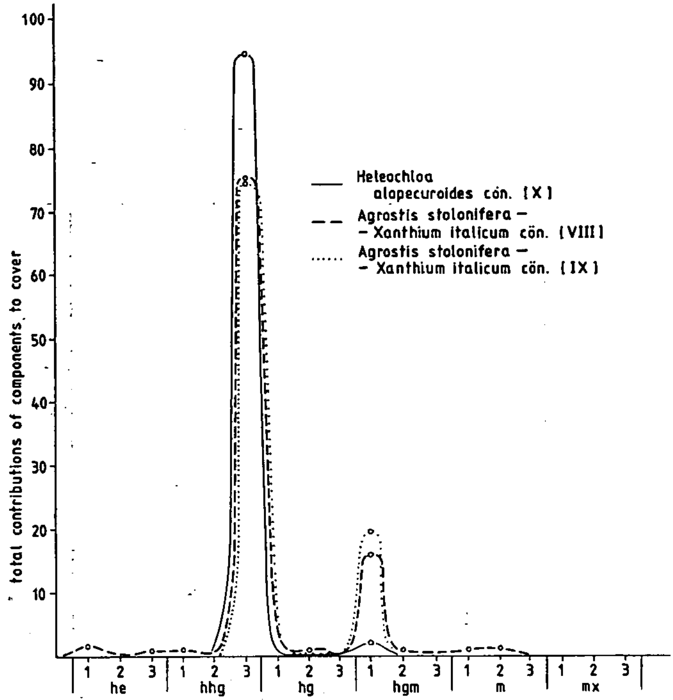


Fig. 13. Comparative hydroecological curves of the *Heleochloa alopecuroides* and the *Agrostis-Xanthium italicum* complex-cenoses.

Heleochloa alopecuroides cenosis (X)

The area located deeper than -2,1 m was no further covered by water after 19th July. At the time of the study dated 10th August, the area was covered by the blooming state of the *Heleochloa alopecuroides* cenosis as observed on Figure 15. The soil sampling was accomplished on November 5, 1982.

Cenological relations

Regarding species composition, this mud cenosis is rather poor in species, standing mostly of Cyperio-Spergularion and Bidentetea, respectively, as well as of Calistegion. The dominancy of the long-lasting surface water and the possibilities provided by the short vegetation period were firstly favourable for the *Heleochloa alopecuroides,* being of *hhg3* nature; thus having wider ecological adaptability from hydroecological point of view. The *Xanthium italicum* also showing great adaptability, and which — as mentioned earlier — could be regarded as *hgm*1 representative within the hygro-mesophyton category, had lost its dominating role, and had continuously extended towards the deeper zone. Nevertheless, the *Agrostis stolonifera* was still not detectable within this inner zone. The endurance of the *Glycyrrhiza echinata* belonging to the *hg*1 subgroup was, however, not expectable (Table 5).

Regarding the hydroecological total covering quota of the mud cenosis, the *hhg3* subunit played a role in close to 100% (Fig. 13).

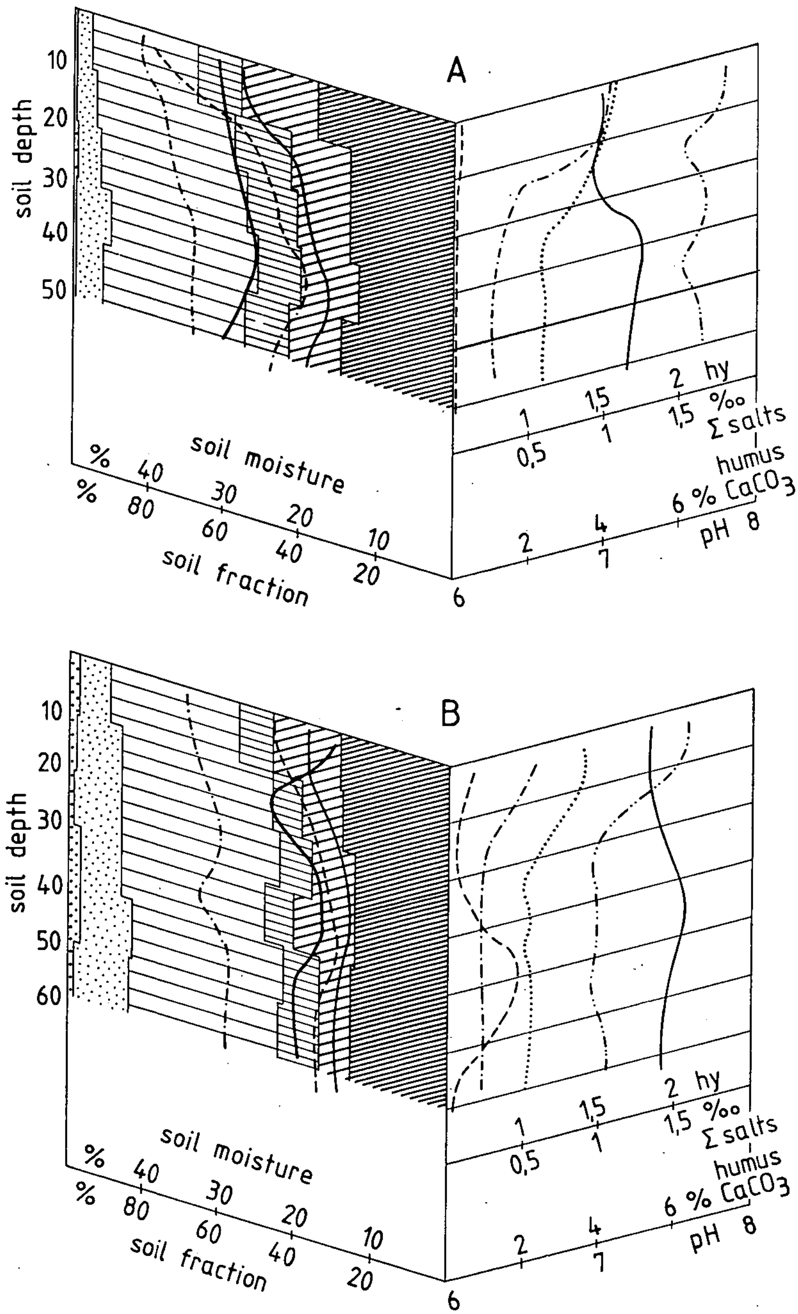


Fig. 14. The physical, chemical and hydroecological characteristic data of the A (VIII) and B (IX) soil segments of *Agrostis stolonifera — Xanthium italicum.*

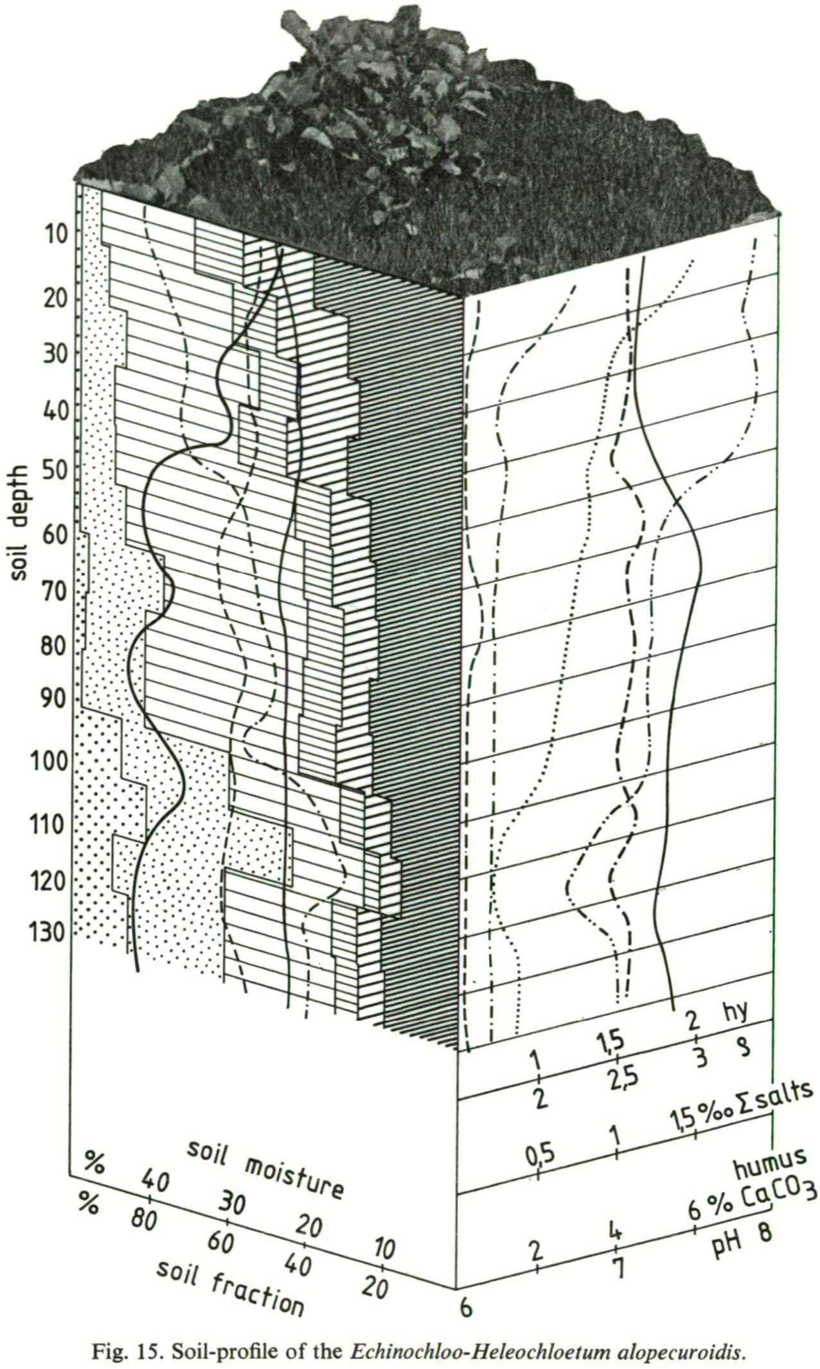


Fig. 15. Soil-profile of the *Echinochloo-Heleochloetum alopecuroidis*.

Soil relations:

In this cenosis, the 130 cm deep segment reflects well the development of the explored soil profile of the borrow-pit residue excavated more than 50 years ago at the Körös flood-plain. Its gradual siltation is well followable. While the upper 40 cm level of the segment — besides the significant clay fractions — is dominantly mud; progressing downwards, smooth sand combined with a fraction of rough sand becomes dominating. This was also reflected by its moisture-retaining ability. Otherwise, the water content referring to the mass of the soil can mainly be regarded as constant in the segment. The pH of the soil is close to neutral (Fig. 15). The calcium carbonate content is not significant, at the same time, in the upper part of the root zone, a higher — 0,144% — salt content could be determined compared to the previous. Taking into account the moisture relations of the area, it could be determined that it had no effect on the composition of the species components in such diluted state; apart from the *Heleochloa alopecuroides,* no other halophyton occurred.

The lack of other halophyta, the close to neutral chemical reaction of the soil makes the relationship between the *Heleochloa alopecuroides* cenoses and the Cypero-Spergularion association-group doubtful; at the same time, the process of the sucession, and the constant occurrence of the Bidentetea character species refer to the belonging to the Bidention association-group.

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Az Echinochloo—Heleochloetum alopecuroidis (Rapcs. 27) Bodrk. 82. társulásához vezető szukcessziósor Körös-hullámtéri szezonális dinamikája

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József Attila Tudományegyetem, Növénytani Tanszék, Szeged

Kivonat

A Körös-hullámtéren egy földbánya visszamaradt anyagárkában iszapnövényállomány kialakulásához vezető, különböző hidroökológiai igényű és vízelborítottságot tűrő fitocönozis szukcesszió sor vizsgálatára került sor 1982—83-ban. Az anyagárokban az egyes zónák vízelöntöttség tartósságától függően *Alopecurus pratensis-Poa trivialis*→*Potentilla reptans-Xanthium italicum*→*Eleocharis palustris*→*Agrostis stolonifera-Xanthium italicum*→*Carex gracilis*→és végül a *Heleochloa alopecuroides* cönozisok szukcesszió sora alakult ki.

A megszerkesztett koordináta rendszerben az egyes mozaikkomplexeket metsző egyenesek mentén értékelésre kiválasztott reprezentánsok: *Carex gracilis, Eleocharis palustris, Xanthium italicum, Agrostis stolonifera* és a *Heleochloa alopecuroides.* Az egyes fitocönozisok hidroökológiai, talajuk fizikai és kémiai viszonyaik tisztázására állományonként szelvényfeltárásokra, illetve laboratóriumi vizsgálatokra került sor. A szukcessziósor kiértékelése alapján a *Heleochloa alopecuroides* állományainak szoros kapcsolata volt megállapítható a Bidention asszociáció-csoporttal. Mivel talajuk gyökérzónájában csupán enyhe és ugyanakkor felhígult nátriumsó felhalmozódás volt kimutatható, kapcsolatuk a Cyperio-Spergularion SLAVIĆ 48 felé nem valószínű.

Сезонная динамика сукцессионного ряда, ведущего к формированию сообществ Echinochloo- Heleochloetum alopecuroidis (Rapcs 27) Bodrk. в пойме р. Кёрёш (1982—1983)

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Резюме

В 1982—83 гг. в пойме реки Кёрёш во рве, образовавшемся после вывоза оттуда земли на строительство, было проведено исследование сукцессионного ряда фитоценозов с различными гидро-экологическими требованиями и способностью выдерживать покрытие водой,

которые ведут к формированию растительного состава ила. В разных зонах рва в зависимости от продолжительности покрытия водой формировался суккцессионный ряд ценозов *Alopecurus pratensis-Poa trivialis→Potentilla reptans-Xanthium italicum→Eleocharis palustris→Agrostis stolomifera-Xanthium italicum→Carex gracilis→Heleochloa alopecuroides.*

В составленной системе координат вдоль прямых, пересекающих отдельные комплексы, *Heleochloa alopecuroides*
Carex gracilis, Eleocharis palustris, Xanthium italicum, Agrostis stolonifera, Heleochloa alopecuroides. для оценки были отобраны:

Для выяснения гидроэкологических условий фитоценозов и физических и химических условий их почвы по каждому ценозу изучали профиль почвы и делали лабораторные анализы. Как показывает ценка суккцессинного ряда, *Heleochloa alopecuroides* находились в тесной связи с ассоционной группой Bidention. Поскольку в корневой зоне их почвы можно было наблюдать лишь небольшое накопление натриевой соли, их связь с Cyperio-Spergularion *Slavnić* 48 мало вероятна.

Sezonska dinamika sukcesivnog niza Echinochloo-Heleochloetum alopecuroidis (Rapcs 27) Bodrk. 82 zajednice u plavnoj zoni Körös-a

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Abstrakt

U 1982—83. godini istraživanjima je bio obuhvaćen sukcesivni niz fitocenoze mulja sa različitim hidroekološkin zahtevima i mogućnošću podnošenja potopljenja. Ispitivanja su vršena u plavnoj zoni Körös-a, u jami nastaloj eksploatacijom zemlje. U zavisnosti od dužine trajanja plavljenja pojedinih zona, u jami je došlo do razvoja sledećeg sukcesivnog niza: *Alopecurus pratensis-Poa trivialis → Potentilla reptans-Xanthium italicum → Eleocharis palustris → Agrostis stolonifera-Xanthium italicum → Carex gracilis →* i na kraju *Heleochloa alopecuroides.*

Za analizu služile su uzorci: *Carex gracilis, Eleocharis palustris, Xanthium italicum, Agrostis stolonifera* i *Heleochloa alopecuroides,* izabrani duž pravih linija koje su u koordinatnom sistemu presecali mozaične komplekse. Utvrdjivanje hidroekoloških osobina pojedinih fitocenoza, kao i fizičko—hemijskih svojstava tla, vršeno je uzorkovanjem zajednica, odnosno laboratorijskim analizama. Na osnovu vrednovanja sukcesivnog niza, utvrdjena je tesna veza izmedju *Heleochloa alopecuoides* i Bidention grupe. Pošto se u zoni korenovog sistema u tlu javlja slaba i razblažena koncentrracija natrijumovih soli, njihova veza sa Cypero—Spergularion *Slavnić* 48 nije verovatna.

Tiscia (Szeged) Vol. XIX, pp. 137—149 (1984)

ФИТОЦЕНОЛОГИЧЕСКАЯ ХАРАКТЕРИСТИКА ЛУГОВ БАССЕЙНА РЕКИ БЕЛОЙ ТИСЫ

В. И. Комендар

На протяжении более 15 лет (с 1966 по 1981 г.г.) проводились исследования послелесных лугов в бассейне реки Белой Тисы. Основное внимание было обращено на изучение ценозов и флористического состава лугов. Исследования проводились в диапазоне от 500—600 м н.у.м. до 1450 м н.у.м.

Белая Тиса образовалась от слияния потока Балцатула, притоками которого являются: Лемский, Липовец, Чуркив, Годорец, Васкул и другие и потока Говерлы, с притоками: Озирный с Брецкулом, Бребенескул с Комарником и др. Потоки Говерла и Брецкул выше села Богдан, в устье Говерлы, сливаются в Белую Тису. С притоков Белой Тисы нужно указать на Богдан, который образуется меньшими ручейками: Рогнескул, Шешул, Лолин, Буркутовый, Свидуватый. Достаточно большим правым притоком Белой Тисы является поток Павлик.

Послелесные луга бассейна реки Белой Тисы занимают в исследуемом районе сравнительно небольшие участки в нижней части склонов, возле усадеб, вклиниваясь отдельными, то малыми, то большими полянами в леса, достигая верхней границ леса. Они, вторичного происхождения — возникли на местах выкорчеваных лесов. Эти луга, или царинки, как их называет местное население, используются как сенокосные угодия. Выпас на них проводится только ранней весной и осенью, после возвращения скота с летних пастбищ. Почва под ними, за данными Н. Б. Вернандер (1946), дерново-буроземная подостланная песчаниками и песковыми сланцами. Мощность их различна в зависимости от крутости склонов. На пологих склонах мощность почвы доходит до 1 м, а иногда и больше. Химический состав, структура и влажность этих почв отображается на характере травостоя лугов. Травостой, как правило, густой и сравнительно богатый за флористическим составом. Состав травостоя изменяется в зависимости от высоты над уровнем моря. В травостое можна обнаружить ряд лесных видов, много видов лугового разнотравья, а в приполонинской полосе — и ряд представителей субальпийской флоры.

Последесные луга чрезвычайно живописны. Их аспект изменяется на протяжении леса несколько раз. Самым распространенным аспектом ранней весной на влажных почвав есть желтый, который образует заросли лютика едкого (*Ranunculus acris* L.); потом, в начале лета, желтый аспект заменяется белым, который образуется нивяником обыкновенным (*Leucanthemum vulgare* Lam.). Реже можна встретить ясно-желтый аспект, образованный родственным язвенником (*Anthyllis affinis* Bertl.).

Наиболее распространенной ассоциацией послелесных лугов является ассоциация с доминированием овсяницы красной (*Festucetum rubrae*). Из других ассоциаций, имеющих меньшее распространение, здесь встречаются: белоусовая (*Nardetum strictae*), белоусово-арниковая (*Nardeto-arnicetum*), арники горной (*Arnicetum montanae*), мятликовая (*Poetum pratensae*), разнотравно-злаково-бобовая. Кроме этих ассоциаций Г. И. Билык (1950) наводит еще луга с доминированием полевицы тонкой (*Agrostis tenuis* Sibth.) клевера ореднего (*Trifolium medium* L.), язвеника родственного (*Anthyllis affinis* Bertl.), клевера расширенного (*Trifolium expansum* W. et K.), клевера лугового и некоторыь других, имеющиь очень ограниченное распространение.

Луга, с доминированием в травостое овсяницы красной

(*Festuca rubra* L.)

Распространены в лесном поясе от 500 до 1400 м н.у.м. на дерново-подзолистых посушливых суглинных или супесчаных почвах со значительным содержанием щебня. Гумусный горизонт определяется достаточно хорошо. В травостое доминирует овсяница красная, которая достигает высоты 40—70 см. Она распространена, как правило, более-менее равномерно. Общее покрытие травостоя овсяницевых лугов до 60—80 %. Микрорельеф слабо выявлен. Летом белый аспект образует нивяник обыкновенный. Травостой овсяницевых лугов богат в флористическом отношении. Здесь, кроме овсяницы, растет еще и ряд других видов. Моховое покрытие почвы составляет 10 %. Как видно из таблицы 1 среди овсяницы красной встречается трясунка средняя, которая выступает содоминантом, а иногда образуются красноовсяницево-трясунковые луга.

На удобренных почвах к овсянице красной примешивается как содоминант клевер луговой (*Trifolium pratense* L.) и тогда образуется красноовсяницево-клеверные луга. Травостой этих лугов бобово-разнотравно-злаковый, густой, двухярусный, с красочным аспектом во время цветения разнотравья. Моховой покров на таких почвах чаще полностью исчезает, или встречается в очень малых количествах.

В таблице 2 мы приводим данные ботанического анализа сена бобово-разнотравно-злаковых лугов. Укос *П* 7 описания 117, взятый на лесной поляне северо-восточного склона Менчула, на высоте 1100 м н.у.м.; укос *П* 8, взятый в устье Говерлы, на высоте 680 м н.у.м.

Из таблицы 2 видно, что гектар бобово-разнотравно-злаковых лугов при одноразовом скащивании дает до 17—18 центнеров сена.

В травостое этих лугов доминирует злаковая группа, среди которой доминирует овсяница красная и полевица тонкая. Достаточно богато представлены бобовые и очень мало осоки. Разнотравья меньше, нежели злаков, но больше чем бобовых.

В кормовом отношении — это высококвачественные сенокосы. Ценные кормовые травы составляют 65 % от всей массы сена; 9,175 % припадает на труху, а остальную массу сена составляют удовлетворительно, плохо или совсем не поедаемые травы. Следует отметить, что в травостое содержится довольно большой процент ядовитых растений, которые составляют до 9,5 %.

Таблица 1. *Фитоценотическая характеристика формации*

Ассоциация		*Festuca rubra + Leontodon Lanubriale*			*Festuca rubra + Anthyllis polyphylla*			*Festuca rubra + Hypocheris uniflora*		
Номер и дата описи		24, 30. VII. 74			29, 31. VII. 74			11. 1. VII. 74		
Географический пункт		ур. Пластивник			ур. Гагулянка			ур. Веснарка		
Высота над уровнем моря, м		990			490			1000		
Экспозиция, оклон в градусах		Сев. вос. 20			Юг. вос. 15			Сев. вос. 8		
Микрорельеф										
Общее покрытие в %		100			100			100		
Аспект		Желтовато-фіолетовый			Беловато-желтый			Желтовато-фиолетовый		
Названия растений		Ярус	Обилие	Фенофаза	Ярус	Обилие	Фенофаза	Ярус	Обилие	Фенофаза
1	2	3	4	5	6	7	8	9	10	11
1.	Злаки									
1.	*Festuca rubra L.*	I	30	отцв.	I	38	отцв.	I	30	отцв.
2.	*Anthoxanthum odoratum L.*	I	3	отцв.	I	2	отцв.	I	5	отцв.
3.	*Cynosrus aristatus L.*	I	2	цв.	I	3	цв.	I	2	цв.
4.	*Poa alpina L.*	I	2	цв.	I	I	цв.	I	2	цв.
5.	*Agrostis tenuis* Sibth.	I	2	цв.	I	2	цв.			
6.	*Agrostis alba* L.	I	1	цв.	I	2	цв.	I	2	цв.
7.	*Deschampsia caestptosa* L.	I	2	цв.	I	I	цв.			
8.	*Phleum alpinum* L.	I	1	цв.				I	I	цв.
9.	*Briza media* L.	I	2	отцв.	I	2	отцв.			
10.	*Holcus lanatus* L.	I	2	цв.	I	2	цв.			
11.	*Bromus mollis* L.	I	1	цв.						
12.	*Festuca pratensis* L.	I	2	цв.	I	2	цв.			
13.	*Festuca supina* Schur.	II				2	отцв.			
	П. Бобовые									
14.	*Trifolium pratense* L.	III	3	цв.					2	цв.
15.	*Trifolium repens* L.	III	2	цв.	III	1	цв.	III	2	цв.
16.	*Trifolium strepens* Grantz	II	2	цв.	II	1	цв.	III	1	цв.
17.	*Anthyllis polyphylla* Kit.				II	30	цв.			
18.	*Trifolium montanum* L.				III	1	цв.	III	4	цв.
19.	*Lotus corniculatus* L.	III	1	цв.	III	2	цв.	III	2	цв.
	Ш. Ситники									
20.	*Luzula sudetica* (Willd.)	П	2	цв.					1	цв.
21.	*Luzula nemoresa* E. Mey					П	цв.		2	цв.
	IУ. Разнотравье									
22.	*Leontodon danubiale* Jacq.	II	25	цв.	II	5	цв.			
23.	*Campanula patula* L.	I(	3	цв.				II	2	цв.
24.	*Leuncanthenum vulgare* Lam.	II	5	цв.				II	2	цв.

25. *Achillea millefolium* L.	II	1	цв.						
26. *Centaurea Jacea* L.	II	2	цв.	II	3	цв.			
27. *Carlina acaulis* L.	III	3	цв.	III	2	цв.	III	1	цв.
28. *Rhinanthus major* L.	II	1	цв.	II	2	цв.	II	2	цв.
29. *Alchemilla pastoralis* Bus.	III	3	цв.	II	2	цв.	III	3	цв.
30. *Euphrasia stricta* Host.	II	2	цв.	II	2	цв.	III	1	цв.
31. *Campanula glomerata* L.	II	1	цв.	П	1	цв.			
32. *Potentilla erecta* (L.) Hempe	III	2	цв.	III	1	цв.	III	2	цв.
33. *Ranunculus lanuginosus* L.	II	2	цв.	II	1	цв.	II	2	цв.
34. *Prunella vulgaris* L.	III	1	цв.	III	2	цв.	III	1	цв.
35. *Stellaria graminea* L.	III	2	цв.	III	1	цв.	III	2	цв.
36. *Silene latifolia* Mill.	III	1	цв.	II	1	цв.			
37. *Viola declinata* W.	III	1	цв.						
38. *Galium verum* L.	II	1	цв.						
39. *Galium vernum* Scop.	III	1	цв.						
40. *Plantago media* L.	II	2	отцв.				II	2	отцв.
41. *Dianthus carthusianorum* L.	II	1	цв.	II	2	цв.			
42. *Hypercum perforatum* L.	II	1	цв.	II	11	цв.			
43. *Polygala vulgaris* L.	III	1	цв.	III	2	цв.	III	3	цв.
44. *Myosotis palustris* Lam.				III	2	цв.			
45. *Digitalis ambigua* Murr.				I	1	цв.			
46. *Viola biflora* L.							III	2	цв.
47. *Hypoeheris uniflora*Vill.							III	5	цв.
48. *Phyteuma Vagneri* Kern.							II	7	цв.
49. *Thymus serpyllum* L.									цв.
50. *Ranunculus acris L.*							II	2	цв.
51. *Arnica montana* L.							II	2	цв.
52. *Hieracium pilosella.*							II	3	цв.
53. *Gentiana carpatica Wettst.*					III	цв.	III	1	цв.

По данным Г. И. Билыка (1950) урожайность бобово-разнотравно-злаковых лугов составляет 9—12 центнеров с гектара сена. А на участках с постоянным подпочвенным увлажнением возле родников урожайность их значительно выше — 18—20 центнеров с гектара.

Подобные сенокосные луга очень ценные в кормовом отношении и поэтому имеют большое хозяйственное значение. Но при соответственном улучшении урожайность их значительно увеличивается.

Таблица 2. *Данные ботанического анализа сена бобово-разнотравно-злаковых лугов*

П П п/п	Названия растений	Укос П 7 описание П 117		Укос П 8 описание П 120		Средний вес в %	Сьедаемость
		Вес в %	Вес в %	Вес в %	Вес в %		
1	2	3	4	5	6	7	8
	Злаки						
1.	*Agrostis vulgaris* With.	28,350	10,60	41,020	16,75	13,675	сьед. хорошо
2.	*Anthoxanthum odoratum* L.	0,180	0,07	21,670	8,84	4,455	хорошо
3.	*Briza media* L.	2,630	0,99	—	—	0,495	сьед. удовл.
4.	*Calamagrostis arundiaceae* Roth. L.	—	—	4,020	1,64	0,82	сьед. хорошо
5.	*Cynosurus cristatus* L.	—	—	0,270	0,11	0,055	седь. удовл.
6.	*Festuca rubra* L.	71,900	26,95	43,150	18,05	22,50	—"—
7.	*Nardus stricta* L.	1,930	0,72	—	—	0,36	сьед. плохо
8.	*Phleum alpinum* L.	0,900	0,37	—	—	0,185	сьед. хорошо
	Всего:	105,890	39,70	110,130	44,39	42,045	
	Бобовые						
9.	*Lotus corniculatus* L.	4,670	1,75	—	—	0,875	сьед. удовл.
10.	*Trifolium dubium* Sibth.	—	—	29,870	12,35	0,175	—"—
11.	*Trifolium pratense* L.	15,430	5,80	19,900	8,13	6,965	—"—
12.	*Trifolium repens* L.	11,350	4,25	0,420	0,17	2,21	—"—
	Всего:	31,450	11,80	50,190	20,65	16,225	
13.	*Equisetum arvense* L.	—	—	4,670	1,90	0,95	Не сьед.
14.	*Luzula multiflora* Lejeune	0,130	0,05	0,150	0,06	0,03	сьед. хор.
		0,130	0,05	4,820	1,96	0,98	
15.	*Achillea millefolium* L.	0,150	0,04	14,220	5,78	2,91	сьедоб. удовл.
16.	*Alchemilla arvensis* Scop.	—	—	0,300	0,12	0,06	сьедоб. хорошо
17.	*Alchemilla acutangula* Bus.	0,220	0,08	—	—	0,04	сьедоб. удовл.
18.	*Alectrolophus major* Reichb.	13,780	5,17	4,260	1,74	3,455	не сьед. отравл.
19.	*Prunella vulgaris* L.	0,510	0,19	0,100	0,04	0,115	сьед. удовл.
20.	*Campanul patula* L.	—	—	0,800	0,33	0,165	сьед. плохо
21.	*Cardaminopsis arenosa* (L.) Hauck.	1,440	0,54	—	—	0,27	— —
22.	*Cerastium caespitosum* Gilib.	0,100	0,04	—	—	0,22	сьедоб. плохо

ПП П/П	Названия растений	Укос П 7 описание П 117		Укос П 8 описание П 120		Средний вес в %	Съедаемость
		Вес В%	Вес В%	Вес В%	Вес В%		
I	2	3	4	5	6	7	8
23.	*Centaurea Jacea* L.	—	—	1,910	0,78	0,39	сьедоб. плохо
24.	Compositae	—	—	3,570	1,45	0,725	—
25.	*Euphrasia picta* Wimm.	—	—	0,820	0,33	0,165	—
26.	*Galium boreale* L.	2,400	0,90	1,270	0,52	0,71	сьедоб. удовл.
27.	*Galium vernum* Scop.	0,150	0,04	0,120	0,49	0,265	—"—
28.	*Hypericum perforatum* L.	13,400	5,03	—	—	2,515	сьед. плохо ядов.
29.	*Knautia longifolia* (W. K.) Koch	2,440	0,92	—	—	0,46	сьед. плохо
30.	*Leucanthemum vulgare* Lam.	—	—	9,800	4,00	2,00	Не сьед.
31.	*Leontodon hispidus* L.	—	—	3,420	1,40	0,70	сьед. удов.
32.	*Lazerpitium latifolium* L.	2,100	0,79	—	—	0,395	—
33.	*Myosotis palustris* L.	—	—	0,200	0,08	0,04	сьед. плохо
34.	*Plantago media* L.	—	—	2,820	1,15	0,575	удов.
35.	*Plantago lanceolata* L.	—	—	6,820	2,78	1,39	—
36.	*Potentilla silvestris* Neek.	—	—	0,510	0,21	0,105	сьед. плохо
37.	*Potentilla erecta* (L.) Hampe	0,930	0,35	—	—	0,175	—
38.	*Ranunculus acris L.*	2,420	0,91	3,170	1,24	1,075	сьед. ядов.
39.	*Ranunculus polyanthemus* L.	3,020	1,13	—	—	0,565	—"—
40.	*Rumex acetosa* L.	—	—	0,120	0,49	0,245	сьед. хорошо
41.	*Sanguisorba officinalis* L.	—	—	0,500	0,20	0,10	сьед. удов.
42.	*Stellaria graminea* L.	18,000	6,11	1,900	0,78	3,445	ядов.
43.	*Scorzonera rosea* W. et. K.	17,300	5,30	—	—	2,65	сьед. хорошо
44.	*Silene latifolia* (Mill.) Rendle et Britt	1,140	0,43	—	—	0,215	сьед. плохо
45.	*Thymus* sp.	11,430	4,30	—	—	2,15	—
46.	Umbelliferae	6,120	2,30	1,910	0,78	1,54	—
47.	*Viola tricolor* L.	—	—	0,120	0,49	0,245	сьед. плохо
48.	*Viola declinata* W. K.	2,840	1,06	—	—	0,53	—"—
49.	*Viola sylvestris* Lam.	—	—	0,200	0,08	0,04	—"—
50.	*Veronica chamaedrys* L.	1,420	0,53	2,170	0,88	0,705	—"—
	Всего:	101,310 28,50	36,16 10,65	61,030 18,900	26,14 7,70	31,15 9,175	 Не сьед.
	Всего:	267,280	100,00	245,470	100,00	100,00	

Луга, с доминированием в травостое белоуса

(*Nardus stricta* L.)

Распространены, в основном, на лесныь полянах, размещенных на верхних участках склонов, на высоте близько 1000—1400 м н.у.м. на покатых бедных дерново-подзолистых буроземных шебенистых почвах, с достаточно хорошо выявценной кислотностью.

Белоусники, очевидно, образовались в овсяницевых и полевичных сообществ в результате развития дернового процесса.

Основной фон образует белоус, который растет густыми дернинами и занимает до 40—50, а то и 70 % площади. Видовой состав белоусовой ассоциации показан в таблице 3.

Пробная площадь заложена на южном склоне Говерянки на высоте 1340 м н.у.м. Моховой покров состоит из зеленых мхов и покрывает почву на 10—15 %.

Ботанический состав сена белоусовых лугов за данными Г. И. Билыка (1950) такой: злаков 75 %, разнотравья 25 %. Урожайность их составляет 8—10 ц/га сена. Сено низкого качества.

Временами к белоусу примыкает как содоминант арника горная (*Arnica montana* L.), а иногда образуются белоусово-арниковые луга. На исследуемых участках этих лугов мы наблюдали вытеснение белоуса арникой, что также отмечает В. А. Грабар (1951) на полонине Красна—Салаш в с. Усть—Черна.

Луга, с доминированием в травостое арники горной

(*Arnica montana*) L.

Встречаются сравнительно редко на верхних участках склонов лесново пояса на бедных скелетных дерново-суроземных почвах.

Луга с преобладанием арники горной, очевидно, образовались на места белоусово-арниковых лугов. Основной фон обрасует аринка. Аспект— желтый. Прикорневые листки арники плотно покрывают почву, вытесняя другие виды. Моховое покрытие — до 10%.

Луга, с боминированием в травостое мятлика лугового

(*Poa pratensis* L.)

Эти лига распространены редко, в нижней части склонов, вблизи населенных пунктов на пологих участках рельефа, зинимаяа мощные суглинистые влажные дерново-буроземные, подостланные песковиками почвы.

Травостой двуярусный. Фон образует мятлик. Покрывает почву до 50 %. Ранней весной лютик едкий (*Ranunculus acris* L.) образует светло-желтый аспект. Среди компонентов травостоя встречаются и типичные влаголюбы.

Луга, с доминированием в травостое овсяницы луговой
(*Festuca pratensis* HUDS.)

Формация овсяницы луговой занимает значительные площади как в исследуемом районе так и в зоне Карпат вообще. В вертикальном отношении группировки овсяницы луговой имеют достаточно широкий диапазон. Они встречаются от самых нижних месторасположений в исследуемом районе (580—1000 м н.у.м.), хотя часто опускаются и ниже. Эти группировки приурочены, в основ-

Таблица 3 *Фитоценотическая характеристика формации белоуса (Nardus stricta L.)*

Ассоциация	*Nardus stricta + Arnica montana*			*Nardus stricta + Agrostis tenuis*			*Nardus stricta + Anthoxanthum odoratum*		
Номер и дата описи	40, 3. VII. 74			71, 4. VII. 74			63, 3. VII. 74.		
Географический пункт	ур. Тирсянка			ур. Стайки			ур. Чолава		
Высота над уровнем моря, м	980			1000			1200		
Экспозиция, скло в градусах	Юж. скл. 30			Юж. скл. 35			Вост. скл. 30		
Микрорельеф									
Общее покрытие в %	100			100			100		
Аспект	Фиолетово-желтый			Фиолетово-серый			Желтовато-фиолетовый		
Название растений	Ярус	Обилие	Фенофаза	Ярус	Обилие	Фенофаза	Ярус	Обилие	Фенофаза
1	2	3	4	5	6	7	8	9	10
Злаки	11	30	пл.	11	40	пл.	11	45	пл.
1. *Nardus stricta* L.	1	5	пл.				1	4	пл.
2. *Festuca rubra* L.	1	3	отцв.	1	5	отцв.	1	20	отцв.
3. *Anthoxanthum odoratum* L.	1	4	цв.						
4. *Agrostis vulgaris* WITH.	1	3	цв.	1	2	цв.			
5. *Cynosurus cristatus* L.	1	1	цв.	1	30	цв.			
6. *Agrostis tanuis* SIBTH.				1	5	цв.			
7. *Calamagrostis arundinacea* ROTH.				1	3	цв.	1	2	цв.
8. *Phleum alpinum* L.				1	5	цв.	1	5	цв.
9. *Deschampsia caespitosa* L.									
10. *Agrostis alba* L.	11	3	цв.						
Бобовые									
11. *Trifolium montanum* L.	11	3	цв.						
12. *Anthyllis affinis* BERTH.						111	5	цв.	
13. *Trifolium repens* L.							111	5	цв.
14. *Lotus corniculatus* L.							111	6	цв.
15. *Trifolium pratense* L.							111	2	цв.
Ситники									
16. *Luzula nemorosa* E. MEY.	1	5	отцв.						
17. *Luzula multiflora* LEJEUNE							1	5	отцв.
18. *Lzula sudetica* (WIΣΣD.) DC							1	2	отцв.
Разнотравые									
19. *Arnica montana* L.	11	20	цв.	11	10	цв.	8	8	цв.
20. *Potentilla erecte* HAMPE (L.)	111	5	цв.				111	6	цв.
21. *Scorzonera rosea* W. K.	11	5	цв,						
22. *Hypericum perforatum* L.	11	6	цв.	11	5	цв.			

ном, к северным склонам экспозиций 5°—25°. Почвы дерново-буроземные и дерново-подзолистые. Микрорельеф ровный, бугристый и угнутый.

Аспект данной ассоциации белый. который образуется тысячелистником обыкновенным (*Achillea millefolium* L.), желтовато-белый, который образуется нивяником обыкновенным (*Leucanthemum vulgare* Lam. и *Leontodon danubiale* L.,) желтовато-красный, который образуется клевером луговым (*Trifolium pratense* L.) и лапчаткой прямой (*Potentilla erecte* (L.) Hampe.). Почва дерново-подзолистая с хорошо выявленным гумусным горизонтом.

Луга, с доминированием в травостое полевицы тонкой
(*Agrostis tenuis* L.)

Формация полевицы тонкой занимает достаточно значительные площади, как в исследуемом районе, так и в зоне Карпат вообще. В вертикальном отношении группировки полевицы тонкой имеют широкой диапазон. Они встречаются от самых нижних месторасположений в исследуемом районе (500—1000 м н.у.м.), а за данными Малиновского (1975) ценозы встречаются и в субальпийском поясе (до 1800 м н.у.м.). Эти ценозы приурочены у южным склонам экспозиций.

Микрорельеф неровный. Аспект беловато-синий, который образуется нивяником обыкновенным (*Leucanthemum vulgare* Lam.) и колокольчиком раскидистым (*Campanula patula* L.); беловатокрасным, который образуется нивяником обыкновенным (*Leucanthemum vulgare* Lam.) и клевером лучным (*Trifolium pratense* L.). Самые большие площади с доминированием полевицы тонкой находятся в урочищах «Васкул», «Згар» «Погар». Почвы на этих площадях бурые горные, дерново-подзолистые.

Луга, с доминированием в травостое нивяника обыкновенного
(*Leucanthemum vulgare* Lam.)

Формация нивяника обыкновенного занимает значительные площади, как в исследуемом, районе, так и в зоне Карпат вообще. В вертикальном отношении группировки нивяника обыкновенного имеют достаточно широкий диапазон. Они встречаются от самых низких месторасположений в исследуемом районе (500—1000 м н.у.м.), а за данными К. Д. Малиновского (1975) ценозы встречаются и в субальпийском поясе (до 1800 м н.у.м.). Эти сообщества приурочены, в основном, у южным склонам экспозиций 10°—25°.

Микрорельеф этих лугов бугристый. Общее покрытие травостоем 100 %. Почвы дерново-буроземные и дерново-подзолистые. Сенокосные луга удобряются скотом. Аспект белый, который образуется нивяником обыкновенным (*Leucanthemum vulgare* Lam.), тысячелистником обыкновенным (*Achillea millefolium* L.), беловато-фиолетовым, который образуется нивяником обыкновенным (*Leucanthemum vulgare* Lam.) и васильком горькуша (*Centaurea jacea* L.) беловато-желтый, который образуется нивяником обыкновенным и зверобоем пронзеннолистым (*Hypericum perforatum* L.).

Таблица 4 *Фитоценотическая характеристика формации клевера паннонского (Trifolium pannonicum* JACQ.*)*

Ассоциация		*Trifolium pannonicum + Festuca rubra*			*Trifolium pannonicum + Festuca pratensis*			*Trifolium pannonicum + Agrostis tenuis*		
Номер и дата описи		32, 31. VII. 74			69, 31. VII. 74			36, 28. VII. 74		
Географический пункт		ур. Чевханка			ур. Галулянка			ур. Аклежий		
Высота над уровнем моря, м		720			490			890		
Экспозиция, склон в град.		Юг. влс. 20			Юг. вос. 2.			Юг. вос. 20		
Микрорельеф		Опуклый склон			Ровный склон			Опуклый склон		
Общее покрытие в %		100			100			100		
Аспект		Беловато-желтый			Беловато-желтый			Беловато-желтый		
Названия растений		Ярус	Обилие	Фенофаза	Ярус	Обулие	Фенофаза	Ярус	Обилие	Фенофаза
1	2	3	4	5	6	7	8	9	10	11
	Злаки									
1.	*Festuca pratensis* HUDS.	I	2	цв.	I	22	цв.			
2.	*Festuca rubra* L.	I	23	цв.	I	2	цв.	I	3	цв.
3.	*Anthoxanthum odoratum* L.	I	2	пл.	I	2	пл.	I	2	пл.
4.	*Cynosurus cristatus* L.	I	2	цв.	I	2	цв.	I	1	цв.
5.	*Briza media* L.	I	2	цв.				I	3	цв.
6.	*Phleum pratense* L.	I	2	цв.						
7.	*Agrostis alba* L.	I	2	цв.	I	3	цв.	I	2	цв.
8.	*Agrostis tenuis* SIBTH.	I	2	цв.	I	2	цв.	I	13	цв.
9.	*Deschampsia caespitosa* L.				I	2	цв.			
10.	*Holcus lanatus* L.				I		цв.		3	цв.
11.	*Bromus mollis* L.				I	2	цв.			
12.	*Dactylis glomerata* L.				I	2	цв.			
	Бобовые									
13.	*Trifolium pratense* L.	III	2	цв.	III	4	цв.	III	2	цв.
14.	*Trifolium pannonicum* JACQ.	II	40	цв.	II	30	цв.	II	30	цв.
15.	*Vicia cracca* L.	II	2	цв.	II	2	цв.			
16.	*Lotus corniculatus* L.	III	3	цв.	II	2	цв.	III	5	цв.
17.	*Trifolium strepens* GRANTZ.				II	1	цв.	II	1	цв.
18.	*Trifolium repens* L.				III	1	цв.			
19.	*Trifolium montanum* L.				II	1	цв.	II	1	цв.
20.	*Melilotus officinalis* L.				I	1	цв.			
	Ситники									
21.	*Luzula nemorosa* E. MEY.		1		I	2	2	пл.		
22.	*Luzula sudetica* (WILLD.)	II	2	отцв.				I	2	цв
23.	*Luzula multiflora* LEJEUNE				I	1	пл.			

Луга, с доминированием в травостое язвенника многолистного (Anthyllis polyphylla Kit.)

Формация язвенника многолистного занимает незначительные площади как в исследуемом районе, так и в Карпатах вообще. В вертикальном отношении группировки язвенника многолистного имеют малый диапазон. Они встречаются от самых низких месторасположений в исследуемом районе (490—720 м н.у.м.). Эти группировки приурочены, в основном, к южным склонам экспозиций от 5°—10°. Основание травостоя здесь образует язвенник многолистный (*Anthyllis polyphylla* Kit.), высота которой достигает до 40 см, а покров 30—35 %. На отдельных участках до язвенника многолиственного обильно примешивается клевер паннонский, полевища тонкая, овсяница красная, образуя с ним отдельные группировки. Травостой их злаково-разнотравнобобовый, в большинстве случаев трехярусный.

Микрорельеф ровный. Аспект беловато-желтый, который образуется яз-

Продолжение таблицы 4

Разнотравье									
24. *Campanula patula* L.	II	2	отцв.	II	5	цв.	II	8	цв.
25. *Carum carvi* L.				II	2	пл.			
26. *Centaurea jacea* L.	II	2	цв.	II	2	цв.	II	9	цв.
27. *Galium verum* L.				II	1	цв.			
28. *Galium vernum* L.	III	3	цв.	III	2	цв.	III	3	цв.
29. *Leontodon danubiale* Jacq.	III	3	цв.	II	4	цв.	II	2	цв.
30. *Dianthus carthusianorum* L.	II	4	цв.	II	2	цв.	II	3	цв.
31. *Rhinanthus major* L.	II	2	цв.	II	2	цв.	II	3	цв.
32. *Thymus serpyllum* L.	III	3	цв.	III	4	цв.			
33. *Plantago media* L.				I	2	цл.			
34. *Plantago media* L.	II	3	пл.	II	2	цв.	II	2	пл.
35. *Potentilla recta* (L.) HampΣ.	III	3	цв.	III	2	цв.	II	2	цв.
36. *Polygala vulgaris* L.	III	3	цв.	III	2	цв.	I	1	цв.
37. *Alchemilla pastoralis* Bus.	III	2	цв.				III	3	цв.
38. *Leucanthemum vulgare* Lam.	II	10	цв.	II	5	цв.	II	3	цв.
39. *Gentiana carpatica* Wittst.	III	2	цв.				III	2	цв.
40. *Stellaria graminea* L.	III	2	цв.	III	2	цв.			
41. *Hypericum perforatum* Will.	II	2	цв.	II	2	цв.			
42. *Campanula glomerata* L.	II	2	цв.	II	2	цв.			
43. *Carlina acaulis* L.	III	3	цв.	III	2	цв.	III	2	цв.
44. *Euphrasia stricta* Host.	III	2	цв.	III	1	цв.	III	2	цв.
45. *Veronica chamaedrys* L.	III	2	цв.	III	2	цв.			
46. *Antennaria dioica* Gaertn.	III	1	цв.	III	2	цв.			
47. *Betonica officinalis* L.				III	2	цв.	III	2	цв.
48. *Chenopodium album* L.				II	2	цв.			
49. *Genista tinctoria* L.				II	2	цв.			
50. *Plantago lanceolata* L.				II	2	цв.			
51. *Prunella vulgaris* L.				III	2	цв.	III	3	цв.
52. *Sedum acre* L.				III	3	цв.	III	1	цв.
53. *Viola declinata* W.				III	1	цв.	III	2	цв.
54. *Achillea millefolium* L.				II	2	цв.	II	2	цв.
55. *Gladiolus imbricatus* L.				I	5	цв.			
56. *Rumex acetosa* L.				II	1	цв.	II	2	цв.
57. *Ranuneulus acris* L.				II	1	цв.	II	3	цв.
58. *Ranunculus lanuginosus* L.				II	2	цв.	II	1	цв.

венником многолистым (*Anthyllis polyphylla* Kіт.) и белый, который образуется нивяником обыкновенным (*Leucanthemum vulgare* Lам.). Общее покрытие травостоем 100 %. Почвы дерново-буроземные.

Луга, с доминированием в травостое клевера паннонского
(*Trifolium pannonicum* Jacq.)

Формация клевера паннонского занимает незначительную площадь как в исследуемом районе, так и в Карпатах вообще. В вертикальном отношении группировки клевера паннонского имеют малый диапазон. Они встречаются начиная с районов, расположенных на высоте 500—900 м н.у.м. Эти ценозы приурочены, в основном, склонам южных экспозиций 2°—20°. Почвы дерново-буроземные. Микрорельеф ровный. Аспект беловато-желтый, который образуется нивяником обыкновенным (*Leucanthemum vulgare* Lам.) и клевером паннонским (*Trifolium pannonicum* Jacq.), беловатофиолетовый, который образуется клевером паннонским и васильком горькуша (*Centaurea jacea* L.) Видовой состав растений приводится в таблице 4.

Все эти луга, с хозяйственной точки зрения, в большинстве случаев достаточно продуктивны, но при определенном улучшении продуктивность их может увеличиваться в 2—3 раза, а то и в 4 раза. Из мероприятий по поверхностному улучшению очень хорошие результаты дает внесение органических удобрений. Весной на исследуемых участках вносятся удобрения в количестве 200 ц навоза на га или 100 ц фекалий, или 600 гектолитров навозной жижи, или минеральных удобрений. Можна вносить кальцевую селитру в количестве 200—400 кг на га, суперфосфат 200—450 кг. Перед внесением удобрений и после луга следует забороновать. В результате внесения органических удобрений урожайность лугов первого года после удобрения возросла в полтора-два раза, сменился травостой как в количественном, так и в качественном отношении.

На участках, сильно заросших мхом, Г. И. Билык рекомендует проводить боронование луговыми боронами с подсевом семян таких трав: овсяницы красной, овсяницы луговой, тимофеевки луговой, райграса высокого, ежи сборной, сятлика лугового, полевицы белой, клевера лугового, клевера распространенного, клевера среднего. Внесение удобрений и подсев трав некоторые колхозы проводят при помощи сельскохозяйственной авиации.

Кроме этого необходимо проводить борьбу с сорняками, особенно ядовитыми и крупностеблевыми. С этой целью на засоренных площадях сенокос нужно проводить раньше времени созревания сорняков. Этот способ борьбы можна использовать для уничтожения погремка большого.

Щавель и чемерицу нужно уничтожать путем выкапывания их с корневищами с последующим сжиганием.

Коренное улучшение почвы дает урожай намного выше, нежели поверхностное, но оно требует значительных затрат и не везде может быть использовано в горных условиях.

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A Fehér-Tisza völgyének fitocönológiai jellemzői

W. I. KOMENDAR

Uzshorodi Állami Egyetem Biológiai Fakultása

Kivonat

Az Uzshorodi Állami Egyetem biológiai fakultás munkatársai tudományos kutatásait komplex módszerrel végzik, amelyet az egyetem hivatali apparátusa s a Tisza tanulmányozásával foglalkozó magyarországi munkaközösség jóváhagyott. S ebben a komplexusi témakörben én, mint fitocenológus, a Tisza medence növényzetének a fitocenológiai jellemzéseivel foglalkozom.

A Fehér-Tisza mellett elterülő rétek a Tisza jobb és bal partjainak síkságain terülnek el. Egy társulásban 40—50 magasabb rendű növény is található. Körülbelül 250 növény fajt számlálhatunk. Megtalálhatók itt az erdő-rét zóna legfőbb képviselői. Figyelemre méltóak azok a rétek, melyeken az *Arnica montana* és más szubalpesi növények találhatók: *Scorzonera rosea, Soldanella hungarica, Homogyne alpina,* —. Megtalálhatók a sztyeppei növényvilág egyes fajai is.

A fűállomány elég bonyolult, három gyepszintű. A fűtermékek minősége megállapításához botanikai meghatározást alkalmaztunk. A rétek fűhozama hektáronként 13—17 mázsa. Évről évre a réteken szénakaszálás folyik. A rétek tanulmányozása folytatódik.

Phytocenological characteristics of the White-Tisza Valley

W. L. KOMENDAR

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Abstract

The co-workers at the Faculty of Biology of the State University in Uzhorod carry out their scientific research activities with complex methods, approved by the official machinery of the University and the Hungarian team dealing with investigations of the Tisza river. Within the frame of this complex topic, author — as a phytocenologist — carries out studies concerning the phytocenological characterization of the vegetation at the Tisza basin.

The meadows located alongside the White-Tisza are found at the plains, at the right and left banks of the Tisza river. 40—50 plants of higher order can be found within one community, and about 250 plant species can be found at this area, where also the main representatives of the forest-meadow zone are retraceable. Those meadows are noteworthy, where the *Arnica montana* and other sub-alpine plants are found, as the *Scorzonera rosea, Soldanella hungarica, Homogyne alpina* — Certain species of the steppe-flora also grow here.

The grass stand is rather complex, made up of three herb layers. To determine the quality of the grass yields, botanic classification was applied. The grass output of the meadows is 13—17 quintals per hectare. The cutting of hay is performed each year at the meadows. The studying of the meadows is further continued.

Fitocenološke Karakterističnosti doline Bele Tise

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Abstrakt

Saradnici Biološkog Fakulteta svoja istraživanja vrše kompleksnim metodama. Program je odobrio Užgorodski Univerzitet i Radna grupa za istraživanje reke Tisle. U ovom radu je obradena fitocenolška karakterizacija biljki doline reke Tise. Livade pored Bele Tise se nalaze na desnoj i levoj obali reke Tise.

Ove biljne zajednice nose u sebi bogatstvo vrsti, u pojedinoj zajednici može se pronaći 40—50 makrophyton biljki. U pojedinim conozama je ustanovljeno prisustvo 250 vrsti biljki.

Mogu se pronaći najznačajniji predstavnici zone šume—livade. Značajne su one livade na kojima se nalaze *Arnica montana* Sastav travnjaka je prilično složen u večini slučajeva sastoji se od tri dela.

Što se tiče fitomase 13—19 g po hektaru u slučaju redovnog godišnjeg košenja detaljno istražzivanje ovih livada je u toku.

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О РАСТИТЕЛЬНОМ ПОКРОВЕ БАССЕЙНА ВЕРХНЕГО ТЕЧЕНИЯ РЕКИ ЧЕРНОЙ ТИСЫ

С. С. Фодор

Среди многих живописных уголков Советских Карпат, особой красотой пейзажей и багатством растительного покрова выдвигается бассейн верхнего течения реки Черной Тисы. Этот бассейн располагается в северо-восточной части Закарпатья в истоках реки Черной Тисы, среди горных хребтов Полонинских и Водораздельных, Карпат, на высотах в диапазоне 800 и 1800 м н.у.м.

В своем общем морфологическом характере, бассейн представляет широкую цыркоподобную котловину, окруженную с трех сторон высокими, относительно крутыми горами. Водоразцельный хребет представляют здесь Горганы с горами Черная Клева (1700 м), Медвежа (1700 м), Братковская (1750 м). С Полонинских Карпат ограничывает этот бассейн с юго-запада Свидовецкий хребет с горами Менчул (1400 м), Великий Котел (1750 м), Таталука (1700 м), Татулск (1750 м). Апшинец (1740 м). Обе горные образования в северо-западной окраине бассейна объединяет гора Окола, где и берет свое начало Черная Тиса, (1225 м).

Дальше с правой стороны Черная Тиса принимает в свое русло поточки Апщинец и Ворожеска — истекающие с озер ледникового происхождения. С левой стороны вливаются в Черную Тису речки Левковец, Лазещина, Рипинец, Медвенка и Лопушанка имеющие свое начало на южных склонак Горган. Таким образом выросшая Черная Тиса при Рахове («устьреки») соединяется с вторым источником рек Тисы — Белой Тисой. Все источники Черной Тисы играют большую роль в развитии форело-рыбном хозяйстве Закарпатья.

В геологическом профиле — горные образования бассейна Черной Тисы относятся к третичным флидовым образованиям. В структуре которой кроме мелкозернистых сланцевых отложений широкое место занимают крупяозервистые песчаники (Магурский песчаник), а также конгломераты. В отдельных местах также юрские извесняки (Апшинед, Герешаска).

В климатических отношениях бассейн верхнего течения реки Черной Тисы в многих отношениях отличается от других аналогичных речных бассейнов Закарпатья. По многолетным данным среднегодовая температура бассейна, на высотах 800 м н.у.м. (Апшинецкой котловины) определяется в 5,4°С. При чем на горе Турбат (1140 м) эта температура уже снижается к 4 °С. Максимальная температура в бассейне определяется от 14° до 17 °С, а минимальная от —

—6° до —8 °С в феврале. Осадки в бассейне в основном больше всего выпадают на 1200—1400 м н.у.м. В годовых отношениях которые доходят до 1100—1300 мм.

Специфика климатических отношений этого бассейна больше всего проявляется в влажности воздуха. Количество которой заключается в 80—85 %.

Большая влажность воздуха, значительное количество осадков, а также другие естественные условия бассейна верхнего течения реки Черной Тисы, благоприятствуют и развитию буйного растительного покрова, выдвигающая разнообразием лесных и луговых ценозов, особенно же в условиях высокогорного пояса.

Своеобразие красоты и богатство растительного покярова этого бассейна привлекло за собой с давных времен посетителей ботаников, практиков — лесоводов, а также дюбителей-исследователей природы. (На горе Окола, вблизи источника Черной Тисы поставлена мемориальная доска в 1882 году в память первого государственного выездного собрания Общества лесоводов).

По растительному покрову в этом бассейне образовались в Закарпатье самые буйные хвойные леса, а также пышная флора высокогорного пояса.

В настоящее время леса в основном относятся к молодым саженцам еловых лесов. В недавном прошлом старые и взрослые их саженцы были вырублены (речками славлены), а также в 1952—1957 годах ураганами свалены. Старые хвойные леса сохранились здесь живыми только в более защищенных от ураганов местах, а также в зоне защитных лесов при верхней лесной границе, на высотах 1200—1400 м н.у.м.

Леса эти в основном относятся к едьникам сибирского происхождения, мигрированные в бассейн верхнего течения реки Черной Тисы в бореальных веках. Изредка входим в этом бассейне деса буковые или смешанные (буково-еловые с примесью пихтовых и яворовых саженцев). Как исключение встречаем среди ниж также карпатского кедра. В самых речных долинах, еловые леса довольно часто заменяются лесами рябиновыми, а также ольшатниками (серой ольхи).

В лесах бассейна Черной Тисы широко развит кустарниковый подлесок. В составной части которого часто, встречаем произрастание спирею вязолистную, жимолость черную, шиповника альпийского, изредка потом волчье лыко, смородину карпатскую и бузину красную, среди которых потом довольно часто появляются кусты черничников, а также других цветковых растений: по берегам источников, например. *Campanula abietina* var. *flaccida* (WALLR.) JÁV., *Streptopus amplexifolius* DC., *Pulmonaria rubra* SCHOTT., *Campanula Vajdae* PÉNZES, *Cephalanthera longifolia* FRITSCH., *Centaurea marmarosiensis* (JÁV.) CZEREP.

В других местах потом в лесах:

Luzula sylvatica (HUDS.) GAUD., *L. nemorosa* E. MEY., *Carex digitata., C. sylvatica* HUDS., *Circaea intermedia* EHRH., *C. lutetiana* L., *Milium effusum* L., *Stellaria holostea* L., *Senecio Fuchsii* GMEL., *Oxalis acetosella* L. *Mercurialis perennis* L., *Paris quadrifolia* L., *Moneses uniflora* L., *Pirola rotundifolia* L., *Hieracium caesium* FR., *Campanula rotundifolia* L., *Symphytum cordatum* W. K., *Galeobdolon luteum* HUDS., *Dentaria glandulosa* W. K., *D. bulbifera* L., *Lunaria rediviva* L., *Glechoma hirsuta* W. K., *Athyrium filix femina* (L.) ROTH, *Dryopteris Linnaeana* G. CHR., *D. austriaca* (JACQ.) WOYNAR, *Polystichum Braunii* FÉE., u gp.

В геоботанической перспективе леса верхнего течения реки Черной Тисы следует отнести к типам: елово-кустарниковым *(Piceetum fruticosum)* елово-моховым *(Piceetum polytrichosum)*, елово-папоротниковым *(Piceetum filicosum)*, елово-пролесковым *(Piceetum merculiosum)*, елово-ясменниковым *(Piceetum asperiliosum)*, лесам высокотравным *(Piceetum altiherbosum)*, а при их верхней лесной границе появляются леса ожиковых *(Piceetum lusulieto-sylvaticae)* и леса елово-черничниковые *(Piceetum vacciniosum)*.

С флористической стороны больного внимания заслуживает в лесах верхнего течения реки Черной Тисы — долины отцельных горных источников.

Среди большего количества высокотравных видов произрастают здесь отдельные вицы, мало встречаемые в других местах Закарпатья. В том числе: *Aconitum bucoviense* ZAPAL. *Valeriana ambiqua* GRENET et GODR., *Vicia sylvatića* L., *Galium elongatum* PRESL., *Achillea stricta* SCHLEICH., *Senecio subalpinus* KOCH., *Cirsium rivulare* (JACQ.) LINK., *Festuca gigantea* VILL., *Valeriana sambucifolia* MIK., *Knautia dipsacifolia* (HOST.) GREN., *Filipendula denudata* (PRESL.) FRITSCH., *Cardamine rivularis* SCHUR., *Angelica sylvestris* L., *Heracleum spondylium* L., *Pleurospermum austriacum* (L.) HOFFM. u gp.

К характеру лесов верхнего течения реки Черной Тисы следует отнести отсутствие в них крупных площадей послелесных лугов — широко развитых в других лесах Закарпатья. Мы их находим только в отдельных участках по берегам рек и при горных потоках. Луга эти отличаются большим количеством видов растений, где доминирующими являются злаки, осоки, и сложноцветные.

В геоботаническом аспекте луга эти надо отнести к следующим сообществам:

На юго-западных экспозициях 900 м н.у.м. образовались в основном луга типа *Festuca rubra* L.+*Campanula patula* L., *Festuca rubra* L.+*Trifolium medium* L., *Trifolium pratense* L.+*Alectorolophus major* (EHRH.) RCHB. u др. В травостое этих ассоциаций насчитываются больше 300 видов растений. Из которых больше всего относятся к злакам.

Ко второму типу послелесных лугов следует в бассейне верхнего течения реки Черной Тисы отнести к осоково-злаковые лугах. Их встречаем в основном в небольших участках по берегам поточков и источников, а также на перевлажненных ложбинках в лесах. В травостое этих лугов из осок в основном доминируют: *Carex vulpina* L., *C. stellulata* GOOD., *C. gracilis* CURT., а из злаков *Festuca rubra* L., *Cynosurus cristatus* L., *Agrostis vulgaris* WITH.
В этих ассоциациях насчитываются больше 40 видов растений *Valeriana tripteris* L., *Trifolium spadiceum* L., *Trollius europaeus* L., *Myosotis palustris* WITH., *Orchis maculata* L., *Caltha palustris* L., u др.

Выше 1200 м н.у.м. леса, как таковые, в бассейне верхнего течения реки Черной Тисы перестали существовать. Они здесь постепенным сокращением и разреживанием переходят в кустарниковые и луговые сообщества — высокогорного пояса.

Несмотря на близкое расположение двух горных образований этого бассейна — Горган и Свидовецкого массива, в растительном покрове они сильно отличаются друг от друга. Горы Свидовецкого массива (Апшинець, Татарика Татулека, Великий Котел и др.) выделяются широко развитыми ольшатниками (криволесья ольхи зеленой) в субальцийском поясе. В древостое этих лесов кроме ольхи зеленой встречаются также отдельные экземпляры черемухи скальной *Padus petraea* PAWL., явор (*Acer pseudoplatanus* L.), горная ель *(Pinus montana* SCOP.) и др. Широко развиты на Свидовецких горах также можжевельник сибирский (*Junierus sibirica* BURG.)..

Из травянистых растений, под пологом ольшатников обильно встречаем произрастание *Deshampsia caespitosa* (L.) *P. B.*, *Luzula sylvatica* (Huds.) Gaud, а также в большом количестве папоротников и мхов (в том числе и белых). На влажных камянистых осыпах в отдельных случаях встречаем виды растений, мало известных в других местах Закарпатья, как например: *Epilobium alsinaefolium* Vill., *Allium sibiricum* L., *Sedum purpureum* (L.) Schult., *Sagina saginoides* (L.) Dalla—Tarre, *Sedum fabaria* Koch, *Pinguicula vulgaris* L., *Aronicum carpaticum* Gris, *Viola biflora* L., *Cardaminopsis ovirensis* Thell., *Heliosperma quadrifida* (L.) Rchb. и др. при чем на отдельных местах под ольшатниками среди моховых зарослей также *Selaginella selaginoides* (L.) Link.

Среди зарослей можжевельника сибирского не редкими видами являются из травянистых элементов также *Festuca rubra* L., *Agrostis canina* L. *Campanula napuligera* Schur., *Aconitum gracile* Rchb., *Phyteuma Vagneri* Kern., *Helleborus purpurascens* W. K., var *Tuzsoni* Andr., *Poa Chaixi* Vill.

Луговые сообщества («полонины») расположены на этих местах на гребнях, некрутых склонах, в субальпийском поясе среди зарослей можжевельников и зарослей криволесий. На этих лугах из злаков в основном доминируют: *Nardus stricta* L., *Festuca rubra* L., *F. ovina* L., *Deschampsia caespitosa* (L.) P. B., *Agrostis vulgaris* With., *Poa annua* L., *P. Alpina* L., среди которых обильно выступают также такие элементы, как *Carex sempervirens* Vill., *Meum mutellina* Gaertn., *Hieracium alpinum* L., *Gentiana pyrenaica* L., *G. Kochiana* Pers. et Song., *G. carpatica* Wettst. и др. На низних пологах этих дугов, где проходит интенсивннй выпас скота, в травянистом покрове обильно встречаем произрастение таких элемеитов как *Rumex alpinus* L., *Homogyne alpina* (L.) Cass., *Potentilla aurea* L., *Hierarcium aurantiacum* L., *Alchemilla pastoralis* Bus., *Hypochoeris uniflora* Uill., *Arnica montana* L., *Scorzonera rosea* W. K. и др. Черничники на этих полонинах в сравнении с другими полонинами Закарпатья ме занимают большие площади (не больше 10 %). Их встречаем в основном на соверных склонах.

Урожайность этих полонив как по задержанности, так и по качеству травосмеси следует отнести к лучшим полонинам Закарпатья. (40 ц зеленой массы с 1 га площаки). Белоус занимает здесь только 45 %).

К специфике высокогорного пояса Свидовецких гор в бассейне реки верхнего течения реки Черной Тисы, надо отнести существующие здесь отдельные болота и озера (Апщинецкое, Ворожаска, Герешаска). Их образование следует отвести к временам ледникового периода, возникших на этих местах под действием скользающих ледников. Озера эти довольно глубокие (до 20—30 м) и отчасти регулируются атмосферическими водами.

В озерах, а также в образовавших торфянистых болотах в окрестностях этих озер произрастает своеобразная флора, мало встречаемая в других местах высокогорного пояса.
Batrachium trichophyllum (Chaix) Bossche, *B. Giliberti* V. Krecz., *Sparganium affine* Scknizl., *Carex limosa* L., *C. pauciflora* Lightf., *Eriophorum vaginatum* L., *E. Scheuchzeri* Hoppe, *Juncus triglumis* L., *J. castaneus* Sm., *Pinguicula vulgaris* L. при чем на торфянных подушках в немалом количестве встречаем произрастание *Oxycoccos palustris* Pers., *O. microcarpa* Turcz., *Andromeda polifolia* L., *Drosera rotundifolia* L.

В флористической перспективе в высокогорном поясе бассейна верхнего течения реки Черной Тисы большой интерес представляет флора произрастающая на скалах, скальных выходах материнских горных пород. Особенно же извеснякового содержания. Среди них такие как: *Scabiosa columbaria* L., var. *pseudolanceolata*. FODOR, *Aconitum Degenii* GAY., *Centaurea Kotschyana* HEUFF., *Aquilegia nigricans* BAUMG., *Allium montanum* SCHMIDT *Gentiana ciliata* L., var. *alpina* FODOR, *Taraxacum laevigatum* (WILLD.) D. C., *Trifolium pratense* L. ssp. *nivale* SIEB., *Bupleurum ranunculoides* L., var. *alpinum* FODOR, *Knautia pocutica* SZABÓ, *Aster alpinus* L. var. *glabratus* (HERB.) WOL., *Solidago alpestris* W. K., *Astragalus Krajinae* DOM., *Galium suberectum* KLOK. u др. Горганы в растительном покрове в определенных чертах отличаются от Свидовецкого массива.

Одьшатники в криволесьях, например, здесь в значительной мере заменены горной сосной (*Pinus mughus* WILLK). На северных скловах, а также на вершинах и гребнях Горган в широких площадях развивается выскогорная «тундра» (сообщества голубики, водяники, плаунов, мхов с лимайниками). Своеобразным бедным травостоем развиваются в высокогорном поясе этой горы луга («полонины»). В травостое которых сокращаются щироколиственные и розеточные сочные травялистые элементы, а их места в более широких площадях занимают белоусниковые, овсянниковые и луговиковые сообщества.

В заключении следует подчеркнуть, что растительный покров бассейна верхнего течения реки Черной Тисыи меет своеобразный характер. В немп роизрастают ряд интересные технические, лекарственные, фруктово-ягодные и кормовые растения — до сих пор недостаточно йспользованные в народном хозяйстве. Одновременно, среди них имеются и виды такие, которые являются редкостными элементами нащей флоры, в связи с чем заслуживают свою охрану.

К таким следует отнести: *Galium suberectum* KLOK., *Allium sibiricum* WILLD., *Taraxacum nigrigans* (KIT.) RCHB., *Knautia pocutica* SZABÓ, *Tozzia carpatica* VOLOCZ., *Phyteuma Vagneri* KERN., *Campanula Vajdae* PÉNZES, *Cardaminopsis arenosa* var. *dependens* BORB., *Aconitum Degeni* GAY., *Valeriana ambigua* GRENET et GODR., *Pulmonaria Filarszkyana* JÁVORKA, *Aster alpinus* L. var. *glabratus* (HERB.) WOL., *Solidago alpestris* W. K., *Astragalus Krajinae* DOM. u др.

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A Fekete Tisza völgyének florisztikai és geobotanikai viszonyai

FODOR I.

Az Uzshorodi Állami Egyetem Biológiai Fakultása

A Fekete Tisza völgye az Északkeleti Kárpátok délnyugati lejtőin terül el. Alapjában véve ez a katlan 850 m magasan fekszik a tenger szintje felett. Geológiai szempontból a Fekete Tisza völgye harmadkorú tengerülepedési képződmény.

Éghajlati viszonyok szempontjából — összehasonlítva a többi Északkeleti Kárpátok hasonló völgyeikhez mérsékeltebb jellegű. Ennek következtében itt fejlődött ki az Északkeleti Kárpátok legmélyebb fenyves erdei és magaslati flórája. Köztük egyesével találhatunk cirbolya fenyőt is. Cserjék közül, különösen gyakoriak itt a szillevelű bajnóca, fekete lónicera, alpesi rózsa, kárpáti köszméte és más. A ritkaságok és endemikus növények jelenleg védelem alatt állanak.

Geobotanikai szempontból a Fekete Tisza völgyének növényzetében következő típusokat találhatunk: *Piceetum fruticosum, P. altiherbosum, Fageto-Abieto-Piceetum-oxolidosum, Fagetum dentariosum.* Érdekessé teszi a Felső Tisza völgyét az itteni sziklák, tengerszemek partjain és jégkorszakbeli keletkezésű tőzeges mélyedésekben fejlődő flóra. Például a sziklákban a *Leontopodium alpinum* CASS., *Aster alpnium* L., *Astragalus Krajinae* DOM., *Aquilegia nigricans* BAUMG, *Bupleurum ranunculoides* L. ssp. *alpinum* FODOR.

Tőzegmocsarakban gyakori itt a *Eriophorum varigatum* L., *E. gracile* KOCH., *Pinguicula alpina* L., *Oxicocus palustris* PERS., *O. microcarpus* TURCZ. et KUPR., *Drosera rotundifolia* L., *Andromeda polifolia* stb.

The floristic and geobotanic relations of the Black Tisza-valley

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Abstract

The Black Tisza-valley is located at the South-Western slopes of the North-Eastern Carpathian Mountaines. Basically, this basin lies in a height of 850 m above sea level. From geoogical point of view the valley of the Black Tisza is a tertiary marine deposit formation.

From the viewpoint of climate relations, it is of more moderate character compared to the similar valleys of the other North-Eastern Carpathian Mountains. As a consequence, the depeest pine-forests and mountain flora of the North-Eastern Carpathian Mountains developed here. Among them, individuals of cembra pine can also be found. From the shrubs, particularly frequent are the elm-leaved meadow-sweet, black lonicera, Alpine rose, Carpathian goose-berry and others. The rarities and the endemic plants are under protection at the present time.

From geobotanic point of view the following types can be found from the vegetation of the Black Tisza-valley *Piceetum fruticosum, P. altiherbosum, Fageto-Abieto-Piceetum-oxalidosum, Fagetum dentariosum.* The valley of the Upper Tisza is made intriguing by the flora developing on the rocks, at the bank of the mountain lakes and in the peaty dips originating from the Ice-Age. The examples of these among the rocks are: *Leontopodium alpium* CASS., *Aster alpinum* L., *Astragalus Krajinne* DOM., *Aquilegia nigricans* BAUMG., *Bupleurum ranunculoides* L. ssp. *alpinus* FODOR.

The *Eriophorum variegatum*L ., *E. gracile* KOCH., *Pinguicula alpina* L., *Oxicocus palustris* PARS., *O. microcarpus* TURCZ. et KUPR., *Drosera rotundifolia* L., *Andromeda polifolia,* etc. are frequent here in the peat-marsh.

Floristički i geobotanički odnosi doline Crne Tise

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Abstrakt

Dolina Crne Tise se nalazi na južnim padinama severno—istočnih Karpata. Nadmorska visina ove kotline je 850 m. U geološkom pogledu ova je tvorevina.

Usled kontinentalna klime u ovom području se nalazi borovnjak i visokoplaninska flora severno-istočnih Karpata. Značajan broj retkih endemiskih vrsti stojgi pod zaštitom. Sa tačke gledišta geobotanike u dolini Crne Tise mogu se izdvojiti sledece vrste biljki: *Piceetum fruticosum* druge. Na stenama kraj doline i na obalama planinskih jezerca su pronadeni ostaci ledenog doba, u tresetnim dubinama je pronaden čitav niz retkosti kao napr: *Leontopodium alpinum* Cass. Na tresetistima su česti *Eriophorum varingatum* L. itd.

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MINERAL SUBSTANCES OF AQUATIC AND TERRESTRIAL VEGETATION IN THE STORAGE TANK AT KISKÖRE

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Abstract

The analysis of 72 plant specimens was carried out for 11 elements at the end of June, 1982. Apart from the species of the littoral zone, the retraceable species of Myriophyllo-Potametum and Nymphaeetum albo-luteae were also evaluated. In contrast with the alarming salt and heavy metal accumulation observed in the flood-plain of the Tisza, the composition of the vegetation is the customary in the water of the storage tank and on the overlands protruding as islands. From the more critical elements the averages of the 54 terrestrial specimens were as follows P=2,0 g/kg, Mg=1,9 g/kg, Na=0,8 g/kg, Zn=42,6 mg/kg and Cu=7,5 mg/kg. Although regarding several elements the concentration of the mineral substances of the reed-grasses surpassed the values measured in the plants of the littoral zone, these can also be considered as normal. The chemical composition give the possibility to distinguish certain taxa, too.

Introduction

In view of the great economical and environmental protection significance of rivers the Hungarian flood vegetation is beign analysed systematically for several macro- and microelements. Besides many generalizable regularities (salt leaching and accumulation), in this manner such factors could also be identified, which restrain either the plant production, or the productivity of the animals consuming the hay of the flood-plains. There are detailed data on the whole Zala river (TÖLGYESI and KÁRPÁTI 1977) as well as the Hungarian upper reach of the Danube (KOZMA and TÖLGYESI 1979). The botanic and chemical surveying has also been carried out at many riverside sectors of the Hungarian upper (TÖLGYESI 1982) and middle reach (KOZMA and TÖLGYESI 1979, TÖLGYESI and KOZMA 1982) of the Tisza. The following review has been compiled from the area of the storage tank at Kisköre.

Materials and Methods

On June 30, 1982, 18 water plant samples were collected from the water of the Kisköre storage tank, and 54 littoral vegetation samples from the two sides of a canal deepened into the water basin. Following dehydration, the plants were digested in the mixture of HNO_3 and $HClO_4$ and the elements were mostly determined with the help of Perkin—Elmer 5000 type atomabsorption spectrophotometer. Divergent from this, the sulphur was measured turbidimetrically, the phosphorus with ammonium-molybdate, and the aluminium with eriochromecyanide colorimetrically.

Results

The 18 water plant samples representing 7 species (Table 1) did not incorporate into their organism more mineral substances than was earlier determined in Hungary

Table 1. *Composition of aquatic plants in dry matter collected from the storage tank at Kisköre.*

	K	Ca	P	S	Mg	Na	Al	Fe	Mn	Zn	Cu
	g/kg						mg/kg				
Nymphaea alba	26,7	8,4	3,37	3,2	1,16	13,78	518	525	356	31,6	3,8
Nymphaea alba	29,0	5,4	5,43	2,4	1,63	16,40	654	613	210	34,9	3,3
Trapa natans	14,8	27,3	4,16	3,6	7,28	3,58	280	521	414	52,6	9,9
Trapa natans	14,5	21,0	3,50	3,7	7,43	3,70	399	627	407	58,4	8,5
Trapa natans	12,0	20,1	3,43	3,9	5,88	2,95	527	592	412	59,6	8,2
Nymphoides peltata	25,7	6,4	3,69	2,9	3,49	6,94	501	1001	241	31,3	4,7
Nymphoides peltata	32,1	5,4	4,09	4,2	2,23	8,09	578	1375	150	47,8	8,2
Nymphoides peltata	31,7	5,8	4,70	3,9	2,79	7,63	391	663	190	35,7	5,4
Nymphoides peltata	12,2	2,0	2,44	3,5	1,07	2,21	727	486	161	35,2	8,0
Nymphoides peltata	19,7	5,0	3,43	2,9	2,27	2,66	756	596	490	51,0	6,0
Nymphoides peltata	25,8	5,4	3,83	3,2	2,52	5,48	731	1189	751	56,0	5,3
Polygonum amphibium	26,9	12,6	5,67	2,8	2,70	1,97	544	1410	339	51,6	8,7
Polygonum amphibium	25,9	27,6	6,09	2,8	2,95	1,96	637	1551	517	63,3	13,6
Potamogaton natans	30,1	10,7	4,35	4,5	2,45	7,05	421	1339	320	69,9	26,3
Potamogeton natans	26,7	8,2	3,96	4,1	3,31	7,55	584	1410	740	72,2	20,2
Potamogeton lucens	24,6	32,0	2,51	5,9	2,70	9,17	994	1269	659	64,6	23,7
Potamogeton lucens	7,4	8,4	2,51	4,9	1,10	2,91	1147	1269	520	42,1	12,4
Potamogeton pectinatus	13,1	4,0	2,11	2,9	1,21	3,36	909	1234	457	57,7	10,1

Table 2. *Composition of plants in dry matter collected from the storage tank at Kisköre.*

	K	Ca	P	S	Mg	Na	Al	Fe	Mn	Zn	Cu
	g/kg						mg/kg				
Iris pseudacorus	25,1	13,8	2,24	1,4	1,92	0,58	64	70	87	15,4	4,2
Amorpha fruticosa	14,1	8,5	3,17	2,3	1,61	0,37	34	74	22	30,7	13,6
Amorpha fruticosa	15,2	7,3	1,85	1,8	1,23	0,47	27	66	53	20,8	6,1
Trifolium hybridum	21,1	13,5	1,32	2,8	2,75	0,62	110	125	68	26,9	5,0
Vicia cracca	17,5	12,8	1,78	1,9	2,09	0,56	89	137	15	38,5	5,8
Chrysanthemum vulgare	30,0	7,9	1,71	1,9	1,51	0,31	72	117	30	24,4	7,2
Cirsium arvense	17,0	22,9	1,87	6,2	2,57	0,50	80	130	16	33,2	5,6
Eupatorium cannabinum	39,9	14,8	2,77	3,2	3,49	1,20	150	239	121	73,7	17,4
Inula salicina	30,6	13,0	2,47	3,4	1,48	0,79	78	110	50	42,3	6,8
Tussilago farfara	37,7	27,4	1,45	18,7	2,32	0,90	166	176	74	25,8	6,6
Mentha longifolia	25,6	9,0	1,32	2,3	1,62	0,73	129	137	29	10,7	4,7
Lycopus europaeus	30,7	10,0	1,87	2,7	2,61	0,70	91	47	47	56,9	12,7
Lycopus exaltatus	25,2	9,0	1,57	3,6	2,06	0,75	208	208	47	45,4	8,5
Stachys palustris	25,7	8,9	1,98	1,7	1,62	0,62	161	170	292	19,9	7,1
Aethusa cynapium	36,4	16,8	3,30	8,3	2,21	1,07	206	216	622	54,4	15,5
Sium latifolium	34,0	16,6	2,04	5,9	2,84	1,31	76	149	297	32,1	10,3
Polygonum lapatifolium	25,9	10,9	1,45	3,9	2,83	0,72	133	183	913	36,3	10,1
Rumex conglomeratus	14,0	8,2	1,85	2,2	2,28	0,83	76	127	113	20,0	3,3
Rumex palustris	19,4	8,3	1,81	1,9	3,48	1,99	85	104	78	22,1	5,7
Agrostis alba	13,1	2,3	1,25	1,5	0,74	0,51	136	163	132	15,8	3,0
Agrostis alba	13,9	2,2	1,91	2,2	1,20	0,17	30	86	22	28,6	3,8
Alopecurus geniculatus	16,8	3,9	1,58	1,9	1,02	0,12	76	94	181	41,2	71
Alopecurus pratensis	24,4	3,6	1,78	1,7	1,15	0,62	68	111	60	19,2	6,9
Glyceria maxima	23,8	5,4	1,78	2,5	1,26	0,43	48	113	30	23,7	7,9
Glyceria maxima	15,7	1,7	1,50	1,4	0,54	0,49	53	103	153	25,4	3,
Poa palustris	15,6	2,1	1,45	1,7	1,03	0,09	27	60	150	42,1	3,
Echinichloa hostii	24,3	3,2	2,18	3,0	2,04	0,90	40	115	199	45,9	6,1
Carex gracilis	18,1	3,4	1,03	1,9	1,33	0,28	68	89	203	44,4	4,3
Carex riparia	21,8	3,1	1,45	2,0	1,39	0,75	110	127	149	20,0	4,9
Carex vesicaria	17,7	5,9	0,99	1,9	1,65	0,17	127	136	209	18,8	4,7
Juncus effusus	19,5	2,5	1,45	2,5	1,37	0,26	110	122	111	48,9	7,5
Juncus effusus	21,4	2,3	1,71	2,1	1,22	0,46	561	881	156	37,1	8,2
Bolboschoenus maritimus	19,6	3,7	1,58	2,9	1,11	1,29	68	114	273	23,8	6,3
Shoenoplectus palustris	15,6	3,0	1,72	2,9	0,81	2,26	263	199	444	21,0	5,2
Typha angustifolia	24,0	8,2	1,85	3,2	0,97	3,17	30	58	345	22,9	5,4
Typha latifolia	24,1	12,4	1,45	1,8	0,98	1,62	115	[illegible]	1604	17.5	3.0

Typha latifolia	26,4	6,5	2,27	2,4	1,25	2,17	72	121	705	22,6	6,6
Butomus umbellatus	34,3	5,8	2,40	2,8	1,52	2,35	731	606	131	16,3	11,6
Lythrum salicaris	20,7	11,9	1,45	3,7	2,51	1,02	102	182	151	49,3	4,9
Euphorbia lucida	19,5	11,9	2,44	3,9	2,32	0,90	302	103	40	45,5	6,1
Euphorbia lucida	24,1	13,5	2,73	3,6	2,46	0,78	82	96	19	31,3	4,7
Veronica beccabunga	29,2	15,4	2,27	4,1	3,22	0,74	225	272	111	49,7	13,9
Echynocistys lobata	29,2	15,2	2,71	3,4	2,17	0,63	104	138	40	19,5	5,4
Equisetum arvense	24,7	15,5	2,31	8,8	4,48	0,63	108	110	30	49,2	8,2
Solanum dulcamar	31,3	8,6	2,51	2,8	2,07	0,71	60	104	97	36,9	11,3
Vitis riparia, fürt	23,3	11,3	2,90	2,4	2,22	0,66	31	72	29	39,6	10,1
Vitis riparia, levél	9,7	20,5	3,30	1,8	2,02	0,04	159	278	59	23,0	8,5
Vitis riparia,	15,7	8,7	2,31	0,9	1,79	0,71	36	70	19	27,8	8,2
Populus alba	20,5	10,7	2,44	3,9	2,17	0,46	69	173	33	250,0	10,1
Salix alba	21,6	14,2	2,18	3,9	2,16	0,65	127	145	106	209,3	8,5
Salix alba	18,5	9,6	2,18	2,9	2,07	0,93	115	143	192	148,4	19,7
Salix triandra	17,7	12,7	2,11	3,2	2,09	0,45	110	139	60	141,5	6,3

regarding manganese (KÁRPÁTI I., KÁRPÁTI V. and TÖLGYESI 1967) and other elements (TÖLGYESI 1965). These species contain larger amounts of most of the elements contrary to the terrestrial vegetation. For example, in the present study, they absorbed into their organism 7,5 times as much sodium and 2,4 times as much manganese. The amount of aluminium and iron is also higher than in the terrestrial taxa. This is partly due to the fact that despite carefully washing in distilled water, silt fragments might have been retained on the plant surfaces. Owing to this methodological error which cannot be eliminated, the Al and Fe values can be regarded as the amount present in the plant; or an amount somewhat slighter, since the elements adhered to the surface are also included in the result.

There are several possibilities for the chemotaxon omicseparation of the collected plants. Thus, for example, the Nymphaea alba could be characterized by high Na-, and low Cu-concentrations. Besides its characteristically low K/Ca ratio, the Trapa natans is also striking by its large magnesium content. The *Polygonum amphibium*'s P/Mg ratio is the highest among the studied taxa. The *Potamogeton* genus is striking due to its high sulphuric and copper-contents. Significant correlation could be found between the manganese and copper concentrations, as well as the K- and Na-concentrations of the *Nymphoides peltata* collected from the six populations, situated far from each other. However, the taken up aluminium is in negative correlation with the total taken up macroelements, from these the relationship with sodium and phosphorus is even significant.

The littoral vegetation (Table 2) is in every respect of normal composition. The phosphorus content is moderate, and the sodium concentration is only also high in those species which also accumulate a large amount of Na in any other environment: *Bolboschoenus, Schoenoplectus, Typha, Butomus.* The manganese content is rather variant, being high at places. This, however, is by no means the result of anthropogenic effect. The manganese is present in well soluble, divalent, easily uptakeable form in the water-saturated, airless soils. The zinc content is averagely 42,6 mg/kg, that of copper is 7,5 mg/kg, not referring to loading at the time-point of the measurings.

The cause of a few striking values is not to be looked for in the exceptional ecological conditions, but is the taxonomical characteristic reviewed earlier. Thus, the high zinc concentration of Salicaceae (141—250 mg/kg), the high copper content of *Eupatorium cannabinum* (17,4 mg/kg), the high sulphur content of *Equisetum* (8,8 g/kg) are just the same chemotaxonomical characteristics, as is the fact that among the herbaceous species *(Gramineae, Juncaceae, Cyperaceae)* there is a prominence at the most in regard of the manganese content.

As a summary, it can be concluded that at the time-point of the present study, both the aquatic and terrestrial vegetation contained the mineral substances in the customary concentration. In a few cases the nutrient element levels do not even reach the concentration determined earlier in the vegetation of the Tisza flood-plain. Therefore, the determined values can be regarded as essential basic value to which the data to be measured in the future could be compared.

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Vízi és szárazföldi növényzet ásványanyagai a kiskörei tározóban

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Kivonat

1982 június végén 72 növénymintát elemeztünk meg 11 elemre. A lithorális zóna fajain kívü a nagyhínár *(Myriophyllo-Potametum)* és a tündérrózsa hínár *(Nymphaeetum albo-luteae)* fellelhető fajait is értékeltük. Ellentétben a Tisza hullámterében észlelt, aggodalomra is okot adó só- és nehézfém-akkumulációval, a tározó vizében és a szigetként kiemelkedő szárazulatokon a növényzet összetétele a megszokott. A kritikusabb elemekből az 54 szárazföldi minta átlaga: P=2,0 g/kg, Mg==1,9 g/kg, Na=0,8 g/kg, Zn=42,6 mg/kg és Cu=7,5 mg/kg. Bár a hínárok ásványi anyagainak a noncentrációja több elem tekintetében meghaladta a parti zóna növényeiben mért értéket, ezek is kormálisnak tekinthetők. A kémiai összetétel lehetőséget nyújt egyes taxonok elkülönítésére is.

Минеральные вещества водной и полевой растительности водохранилища Кишкёреи

Д. Тёльдеши и А. Козма

Резюме

В конце июня 1982 года был проведен анализ 72 растительных проб на 11 элементов. Кроме видов литоральной эоны, проводилась оценка и встречающихся здесь видов *Myriophyllo-Potametum* и *Nymphaeetum albo-luteae.*

В противоположность отмеченной в долине Тисы и вызывающей опасение аккумуляции солей и тяжёлых металлов, состав растительности как в воде, так и на выступающих в виде осторовов участках суши является обычным. На основе 54 полевых проб установлено следующее среднее содержание критических элементов: P=2,0 г/кг, Mg=1,9 г/кг, Na=0,8 г/кг, Zn=42,6 мг/кг, Cu=7,5 мг/кг. Хотя концентрация минеральных веществ в водорослях в случае многих элементов превзошла соответствующие показатели побережной зоны, её тоже следует считать нормальной.

Neorganske materije u vodenim i suvozemnim biljkama na području akumulacija Kisköre

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Abstrakt

Krajem juna 1982. godina analizirana su 72 uzorka biljaka na prisustvo 11 elemenata. Osim vrsta litoralne zone ispitivane su i vrste *Myriophyllo-Potametum* i *Nymphaeetum albo-luteae* zajednice. Nasuprot zabrinjavajućoj akumulaciji soli teških metala u plavnoj zoni Tise, količina ovih sastojaka u biljkama u vodi akumulacija i na sprudovima je zadovoljavajuća. Prosek kritičnih elementana u 54 suvozemne probe je: P=2,0 g/kg, Mg=1,9 g/kg, Na=0,8 g/kg, Zn=42,6 mg/kg i Cu=7,5 mg/kg. Iako koncentracija mineralnih materija u zajednici *Myriophyllo-Potametum,* u pogledu više elemenata, nadmašuje vrednosti merene u priobalnim biljkama, ona se ipak kreće u granicama normale. Hemijski sastav daje mogućnost i za odredjivanje nekih taksona.

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THE PHENOLOGICAL AND ECOLOGICAL RELATIONS OF THE ACENTRIA NIVEA OLIVIER, 1971; LEPIDOPTERA: ACENTROPIDAE) IN THE BACKWATERS AT MÁRTÉLY-KÖRTVÉLYES

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Abstract

Attention was drawn to the *Acentria nivea* Olivier by an up to now unknown phenomenon, on the basis of lepidopterologic observations carried out continuously since 1969 in the environment protection area at Mártély-Körtvélyes. Since the starting of the observations till 1981 only a minimal number of the species could be observed, then in the following year it was detectable in large numbers. Searching for explanation in this concern, the paper contains a brief review on the development of the species, as well as the hypothetical and real effect of the local circumstances which influenced or may have influenced the development of this species.

Introduction

The selection of the topic has two aims.

The Mártély-Körtvélyes Research Programme has come to an end, the studies in this regard have been prepared. Since the phenomenon being the subject of this report had commenced even before 1969 and had only become noteworthy in 1982, it therefore requires to be included in the terminated programme.

The other aim is to call the attention, arouse the interest of scientists, who will be carrying out further Tisza-research studies in other areas, to the possibility profitable in environment and nature protection of this organism having such peculiar habits — and in all likelihood — filling a part as good indicator. Although this organism is a microlepidoptera, its studying is nevertheless mainly hydrobiologic, biochemical or ecological task.

Results of the research

On the basis of the continuous lepidopterologic observations carried out since 1969 at the Mártély-Körtvélyes environment protection area, it was striking that the *Acentria nivea* — this water-moth having such characteristic habits — was observable in only few number despite the fact that even two generations fly yearly. However, following their minimal occurrence for over ten years, it was even more striking that in August, 1981, 100—120 specimens — opposite to the earlier 5—10 — flew on the lamp-illuminated sheet used for the collection. In the year following its occurrence was mass (Fig. 1). Searching for an explanation to this, let us look into the biology and phenology of the species.

Throughout the world, the Acentropidae family is represented by a single sex, and in Europe this is represented by several subtypes of a single species.

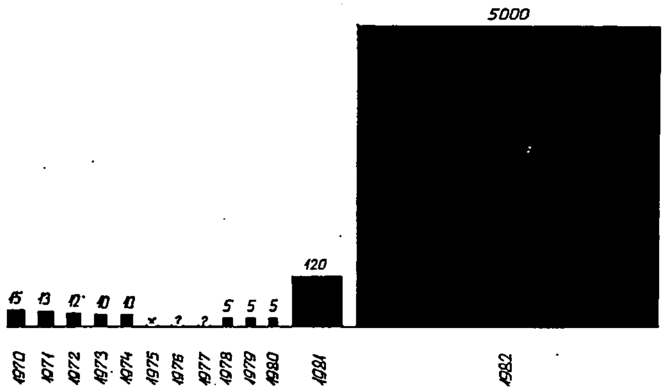

Fig. 1. The years of the study, where the occurring animals are demonstrated by squares proportional to their amount. (In 1975 not a single animal could be collected; in 1976—1977 quantitative studies were not carried out).

Even before the turn of the century a number of well-known researchers dealt with this species, however, many false data and divergent opinions came to light upon their studies. Even around the turn of the century it was debated whether it should be ranked among the *(Trichopteras or Lepidopteras)* due to its strange character. One of the most significant studies was carried out by NIGELL (1908), which is quoted in detail also by HERING (1926) in his book written on the biology of *Lepidopteras* resolving many myths, amending false observations and conclusions about the life of the species. Following this WOJTUSIAK (1935) Polish, and BERG (1941) Danish researchers took a significant step towards the knowledge on the biology of the species. The English scientist, WHALLEY (1966) threw light on its synonymics, since the earlier literary data discuss it using various terms; most of them the term *Acentropus niveus*. The various features of the species were made more clear in so many objects by the forwardness of the research works that in 1978 KUCHLEIN, Dutch scientist, had every cause to raise the species into subfamily rank. The revelation of the species' biological and ecological relations was made even more difficult by the fact that first, in 1925, it was detected by LE CERF in the Mediterranean sea of Spain, and later by others in the warmer seas throughout Europe. It became a matter of general knowledge within the circles of the specialists that the species is firstly native in sea-water.

The differing studies, however, agree in one point; namely, where this species is present, its occurrence is in large numbers.

The eggs are ovoid, yellowish-green in colour, finely indented. The imagos place them close to each other on the host-plant, mainly on the abaxial surface of the underwater leaves. One imago lays 100—140 eggs.

The hatching caterpillars are 0,8 mm long, the developed ones are 10—12 mm, completely adapted to the underwater manner of living. Their stomata are closed, thus they breath through the skin. Their digestive system filled with the green nutriment is visible through their thin skin. They have sixteen legs, their body is whitish-yellow, their annuli are swollen from 4 to 8, their sides are brownish in colour.

The freshly hatched caterpillars make themselves a secure lurking hole. It is not rare that two caterpillars build themselves a common place, neither that they spin back the edge of the leaves with their web, or they only bore themselves into the

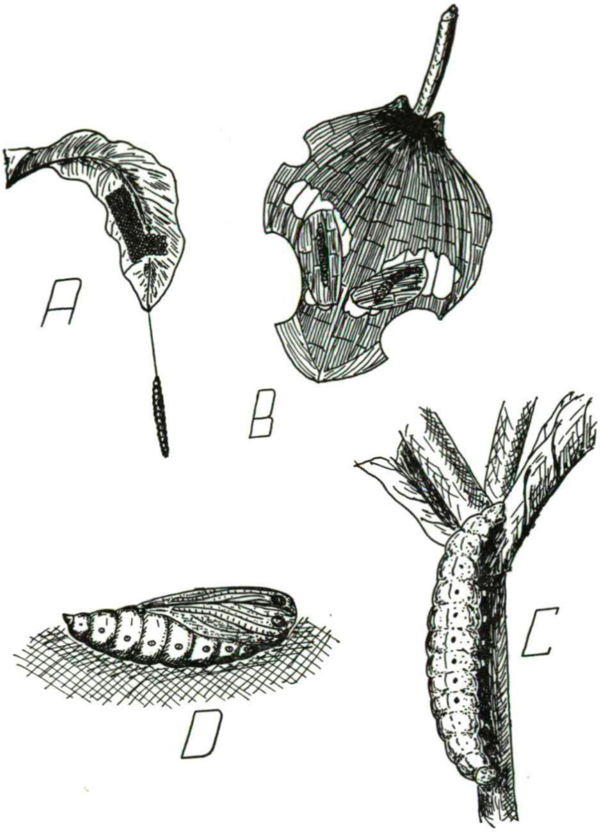

Fig. 2. Acentria nivea O.; A — egg pile; B — lurking-place of young caterpillars; habit-sketch of caterpillar (C) and puppet (D).

plant stem. They mostly favour smooth leaves if possible, and — especially in young state — they avoid leaves that are dirty or not wholly clean due to their algal coating (Fig. 2).

The more developed ones interweave two leaves by their apex and sides, and strengthen this further to the stem of the plant, or to other objects. Their living places are backwaters, on the bottom of which they pupate in air-filled webs.

The breathing of the puppets happens through the stigma. The imago hatching from the puppet comes to the surface of the water with the help of the elevating power of the small bubbles found among the hairy wing-scale (Gozmány 1963). Its wings are opaline-white, but brownish shade can frequently be observed on the upper wings. The wing-span of the females is 18—22 mm, that of the males is 13—15 mm.

A particular sexual dimorphism is characteristic of the species, according to which the females have two forms; one having developed wings capable of flying, and one with rudimentary wings, which form lives under water and only thrusts out its abdomen from the water surface at the period of copulation. It occurs that males and rudimentary winged females fly in copula, just the same as it is frequent that these females drag the copulating males with themselves into the depth of the water (Fig. 3).

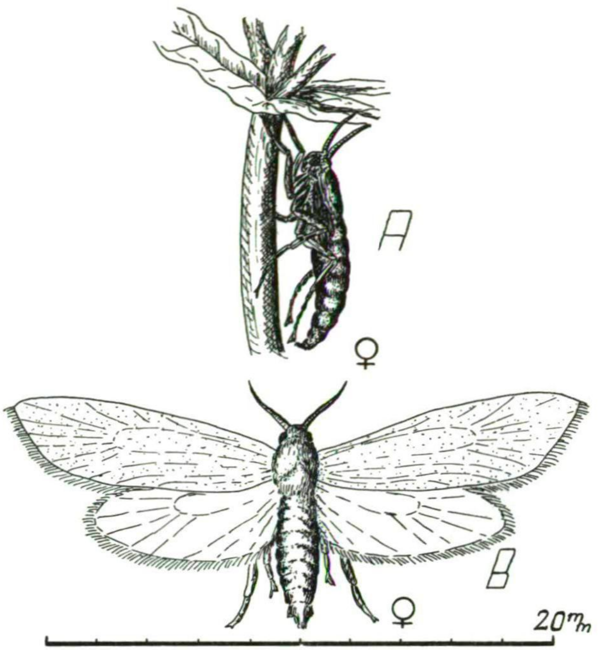

Fig. 3. Female *Acentria nivea* O., — form having rudimentary wings (A), and form capable of flying (B).

The life of the imagos is extremely short. They mostly hatch from pupation period in the evening hours. The copulation takes place during the night, then by morning the exhausted animals rest on the water-plants. The males mostly perish there, and the females under the water, shortly after oviposition. Roving males can only rarely be observed during the day above the water.

The annual two generations fly from the end of March and the beginning of August, respectively, but the two flying periods generally meet. The offsprings of the August generation overwinter as caterpillars. From the offsprings of the vernal generation, not each becomes imago for the Summer population; one part of them overwinter as caterpillars and only take part as imagos among the first generation of the next year.

In the Mártély-Körtvélyes backwaters significant changes took place in the living circumstances of the species; such a process started in 1981, respectively, which increased more in the following year and made possible the mass swarming characteristic in general to the species. The cause of this phenomenon could be made comprehensible by numerous assumptions, from which the most important and perhaps most realistic are the followings.

The development of the species' mass gradation could not have been hindered by the lack of nourishment, since the most common host-plants of the species is known: *Ceratophyllum, Myriophyllum, Potamogeton* (ZELLER, KENNEL, RITSEMA, ENTZ and SEBESTYÉN 1942, GOZMÁNY 1963); and *Elodea canadensis* and *Peplis portula,* resp. (SCHNEIDER, NOVÁK); which can all be found in the backwaters in smaller-larger quantities, but some of them even in high amount.

Let us label the presently unknown factor "K" (Figs. 4A, B).

In the Figure the unknown factor has optionally given theoretical values, to which a few thoughts should by all means be added due to the ascertained being of the sex. The phenomenon detectable in Figures 1 and 4 may have unpredictably many chemical and biological causes. If this factor is of biological nature, such organisms living in water should be counted upon, which with their existence or disappearance changed the ecological conditions necessary for one of the stages of development of the species.

During the period of the long-standing observations the minimal number of the animals may perhaps be explained by the regular malady of the populations, nevertheless, the appearance of the sudden, undiseased stock is difficult to reason. Furthermore, several biological factors can be taken into account. On the other hand, in case the factor searched for is of chemical origin a lot more alternatives can be propounded. Considering the time-points of swarming, there might have been such a change in water quality which did not occur during the last 12 years till 1981, or was present for only a short period, not being able to show an effect on the populations of the *Acentria nivea.*

The possibility of a long-lasting, regular toxicity arose, however, this fact would have been known before the specialists from the analysis of the water samplings. Otherwise, the bacteria living in the water are the most sensitive against various toxicities. Nevertheless, toxicity of such high degree which would have lasted for over ten years was not demonstrable.

Figure 4A shows a considerable change, in which case if it were realistic the "K" factor would have gone through such a great change till the reaching of the high amount of the animals, which would have produced spectacular consequences in several other areas at the backwaters. The studies would be largely facilitated by the finding of such organisms which in the same medium went through similar great changes, correlating with the changes observed in case of *Acentria.*

Widening further the row of characteristics conferred on the unknown factor, it is possible that as the consequence of an effect the dimorphous ratio of the females greatly shifted to the benefit of the rudimentary winged animals. To accept this, the opinion of an insect-hormonal specialist is necessary, however, in case of positive opinion the "K" factor could according to the sense result from the behaviour of the females. They wait for copulation by thrusting out their abdomen from under the water surface. Oil pollution in a thickness of a few microns on the surface would be enough to harm the imagos, which pollution did occur due to the minimal, but unavoidable contamination by grease of the holiday resort motor-boat engines, water conservancy pumps and other machines. These oil stains generally accumulate where dense vegetation rises from the water, and this is mostly where the mentioned females can also be found. A shift in such direction would evidently influence the scope of the male animals, too. This area would mainly be stricted to the surface of the water, therefore — using traditional lepidopterologic instruments — their estimation and collection, respectively, are not possible.

The physical or chemical disintegration of the cocoon walls leads by all means to the death of the puppets, since — as it is known — their breathing takes place through the stigma.

The damage caused by carnivores should not be disregarded either, although the opinion is becoming more and more general that if a population sets out, carnivores are then unable to veritably overtake it, break it down. Yet, in case the damage

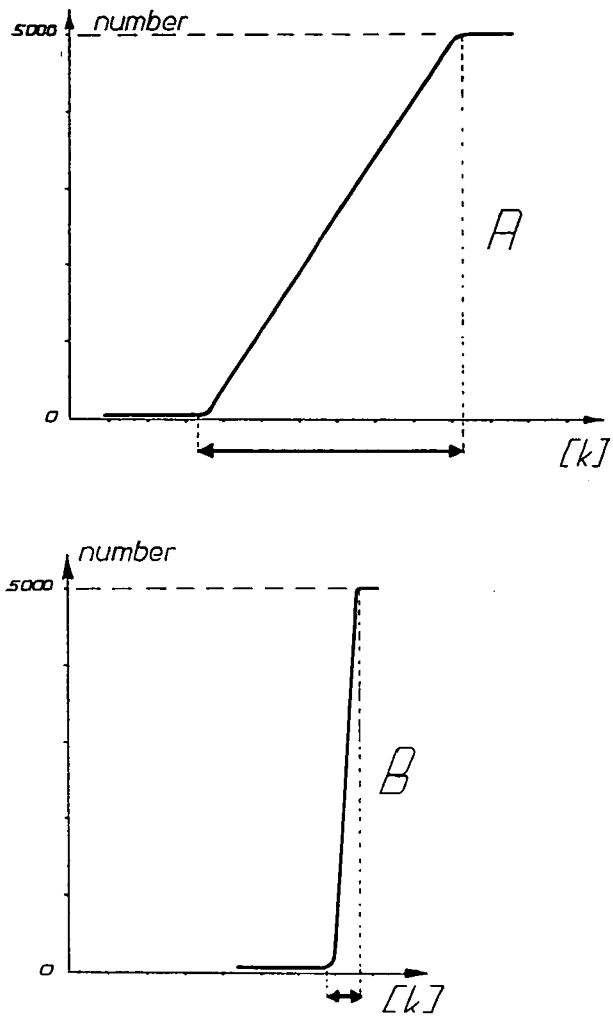

Fig. 4. Factor inhibiting the development of *Acentria nivea* O., and the formation of the number of animals, shown on curves. The development of gradual gradation (A), and gradation without transition (B).

caused by the carnivores was so great, it should have affected the animals of other orders significantly also. However, this was not demonstrable either.

A study demonstrating the ratio of the species' copiousness and mortality due to any causes would be of importance. If the "K" factor is interpreted by the gradual discontinuance of the motive causing the mortality, then a milder curve would be gained after the bottom, latent section of the curve representing the number of animals, nevertheless, this case cannot be compared to the presently reviewed state of the *Acentria* (Fig. 4A).

Every factor which can altogether be taken into account, and of which only very small changes were detectable by specialists participating in the research activity of the Tisza, may have possibly been capable in their total effect to inhibit till a critical limit the normal development of the species, which fact should also be mentioned as an agglomerational relationship. In 1981 this complex factor came close to, then shortly even passed the critical limit-threshold, and resulted a population dynamic, which could be illustrated by a hysteresislike front curve (Fig. 4B).

In the frame of the newer Tisza Research Programme there would be need for a laboratorial experiment series and for one carried out between natural circumstances so that further light could be thrown on the afore-mentioned, unsolved problems. These problems, the favourable and unfavourable effects as to the species, may have probably been long ago determined during the course of the regular bed-related and associate studies, merely their reference to each other with the matter of the *Acentria* had not been accomplished, since the sheer existence of this strange species had not been followed with adequate interest.

The question arises: what if there is no "K" factor? On the basis of the works of KASZAB, KOVÁCS and SCHMIDT the material of the National Museum gives evidence of mass swarming from the regions of Zalavár, Vörs, Királyhalom and Tarhos, however, swarming period is not demonstrable. Beyond our knowledge so far, it comes to light that where it occurs, the *Acentria nivea* is not mass everywhere, and consequently it is also likely that a so far unknown, strong periodical tendency is manifested in the gradation of this species. The complete settling of the expectable gradation period in the area of the Mártély-Körtvélyes backwaters is certainly to be waited for till years.

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Az Acentria nivea Olivier, 1791 (Lepidoptera: Acentropidae) fenológiai és ökológiai viszonyai a Mártély-Körtvélyesi holtágakban

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Kivonat

A Mártély-Körtvélyesi Tájvédelmi Körzet területén 1969 óta végzett folyamatos lepkészeti megfigyelések alapján egy eddig nem ismert jelenség hívta fel a figyelmet az *Acentria nivea* OLIVIER-re. A megfigyelés kezdetétől 1981-ig a fajnak csupán minimális példányszáma volt megfigyelhető, majd a következő évben előfordulása már tömeges volt. Ennek okára keresvén magyarázatot, a tanulmány tartalmazza a faj fejlődésének rövid ismertetését, valamint a helyi körülmények feltételezett és valós hatását, amelyek a faj fejlődését befolyásolták, vagy befolyásolhatták.

Фенологические и экологические условия (Acentria nivea Olivier, 1791 Lepidoptera: Acentropidea) в мёртвых руслах Мартей-Кёртвейеш

Ш. Т. Ковач

Рабочая группа по исследованию Тисы, г. Сегед

Резюме

На территории заповедника в Мартей—Кёртвейеш начиная с 1969 года нами систематически проводятся наблюдения над бабочками, в ходе которых неизвестное до сих пор явление обратило наше внимание на *Acentria nivea* Olivier. С начала наблюдений до 1981 года наблюдалось лишь минимальное количество особей вида, а на следующий год их появление стало массовым. В поисках ответа на вопрос о причинах этого, статья останавливается на кратком описании развития вида, а также на предполагаемом и действительном влиянии местных условий на развитие вида.

Fenološki i ekološki odnosi Acentria nivea Olivier, 1971 (Lepidoptera, Acentropidae) u mrtvajama Mártély-Körtvélyes

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Abstrakt

Tokom kontinuiranih ispitivanja Lepidoptera, započetih u 1969. godini, obratili smo pažnju na dosada nepoznatu pojavu kod *Acentria nivea* Olivier. U periodu od 1969—1981. godine vrsta se javljala sa minimalnom brojnošću, dok je u 1982. godini došlo do masovne pojave ovog leptira. U cilju objašnjenja te pojave, u radu je prikazan tok razvoja vrste kao i uticaj pretpostavljenih stvarnih faktora sredine, kojisu mogli uticati i pod čijim je dejstvom realizovan razvoj populacije

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DYNAMICS OF LONGITUDINAL GROWTH AND BODY MASS OF ESOX LUCIUS L., BLICCA BJOERKNA L., AND CARASSIUS AURATUS GIBELIO BLOCH IN THE TISA

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Abstract

In the period 1979—1981, the relation between body length and body mass of *E. lucius, B. bjoerkna,* and *C. auratus gibelio,* ranging in age from 2+ to 5+, was investigated. Highly significant and positive correlation between the standard length and body mass was obtained. Correlation coefficients ranged from 0.8671 to 0.9732 *(E. lucius)*, from 0.9215 to 0.9621 *(B. bjoerkna)*, and from 0.9572 to 0.9250 *(C. auratus gibelio)*. The highest fattening coefficient was recorded in *C. auratus gibelio,* then in *B. bjoerkna,* whereas the lowest in *E. lucius*. By calculating the allometric ratios of length to body mass, the differences between measured and calculated values in body mass of certain body length groups were obserwed, ranging from 0.76 to 7.48% *(E. lucius)*, from 0.36 to 2.63% *(B. bjoerkna)*, and from 0.18 to 9.65% *(C. auratus gibelio)*.

Introduction

The knowledge of the allometric ratio of length to body mass of fish populations is of great importance to determining the length of time required for gaining given body mass as related to body length and age, and therefore have practical value in fish production. The data presented in this paper are the result of an extended study on a predator species *E. lucius* and its prey *B. bjoerkna* and *C. auratus gibelio* being widespread alien species (BUDAKOV et *al.* 1979, BUDAKOV and MALETIN 1981, MALETIN and BUDAKOV 1982).

Material and Methods

The material was collected in the period 1979—1981. The number of 48 specimens of *E. lucius,* 88 of *B. bjoerkna,* and a 100 specimens of *C. auratus gibelio* was studied. Age of specimens was determined according to year marks on scales (2+ to 5+). Also, the standard body length (in mm) and body mass (in g) were measured. Ratio of length to body mass was presented by a linear regression:

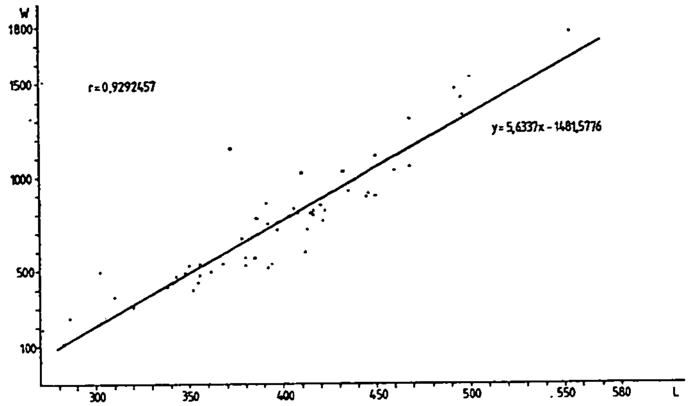
$$y = ax + b$$

Correlation coefficient(r) and fattening coefficient (after Fulton), as related to age, were calculated. Increase in body mass was investigated on the basis of measured values for body mass while ratio of length to body mass was calculated according to the formula:

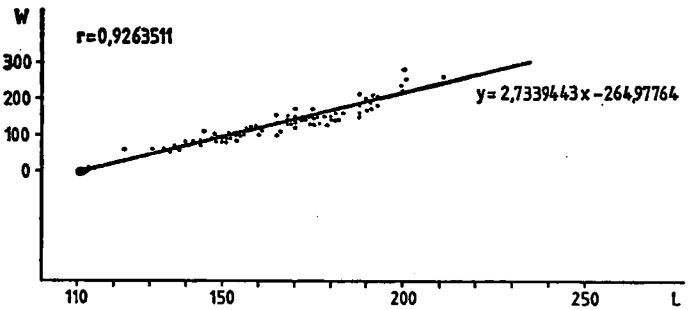
$$\log W = a \log 1 + b$$

Results and discussion

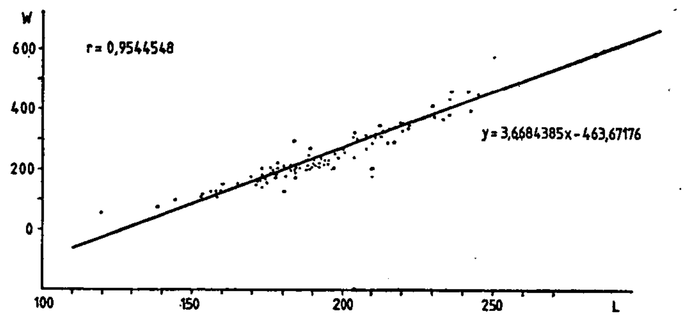
In the graphs 1, 2, and 3, ratio of length to body mass of total sample is expressed by linear regression.



Graph. 1



Graph. 2



Graph. 3

Correlation coefficients of length and body mass were positive and highly significant (*E. lucius*—r=0.9292; *B. bjoerkna*—r=0.9263; and *C. auratus gibelio*—r= =0.9544).

Correlation coefficient of *E. lucius* increased as its age increased, ranging from 0.8761 to 0.9732. Fattening coefficient was the lowest at the age of 2+ (0.9546), whereas the highest at 3+ (1.2817, Tab. 1).

Tab. 1. *The correlation of the standard length and weight and the coefficients of the fattening of Esox lucius L.*

Age	n	r	Q
2+	1	—	0,9545
3+	12	0,8761315	1,2817
4+	21	0,9484364	1,1502
5+	14	0,9732379	1,2053

Values of fattening coefficient were higher than those suggested by Мохов (1979).

Correlation and fattening coefficients in *B. bjoerkna* increased as its age increased ($r=0.9215-0.9620$; $Q=2.4678-2.8717$, Tab. 2). The obtained values are higher than that described by Щербуха (1973).

Tab. 2. *The correlation of the standard lenght and weigtht and the coefficients of the fattening of Blicca bjoerkna L.*

Age	n	r	Q
2+	1	—	2,4678
3+	15	0,9215127	2,6681
4+	41	0,9202878	2,8274
5+	31	0,9620818	2,8717

Correlation coefficient of *C. auratus gibelio,* at the age of 2+ to 4+, was approximately the same ($r=0.9572-0.9599$). At the age of 5+, it decreased slightly (0.9250, Tab. 3). Fattening coefficient decreased as its age increased ($Q=3.5120-3.1810$). Our results are in agrement with the results presented by Кривощеков (1953).

Tab. 3. *The correlation of the standard length and weight and the coefficients of the fattening of Carassius auratus gibelio Bloch.*

Age	n	r	Q
2+	16	0,9572272	3,5120
3+	42	0,9547662	3,4465
4+	28	0,9599360	3,3606
5+	14	0,9250333	3,1810

Ratio of length to body mass of *E. lucius* (Tab. 4) was calculated using the formula $\log W=3.0586 \log 1-5.1095$. This formula served to calculate body mass of certain length groups. By comparing the deviation between calculated body mass and body mass obtained by measuring the same length groups, the smallest deviation was found in the length group ranging from 301 to 340, where the difference amounted 2.77 g, i. e. 0.76%, whereas the greatest was in the group ranging from 541 to 580, where the difference of 132.48 g i. e. 7.48% was recorded.

Tab. 4. *Real and calculated values of the weight (meadle values for separated length groups) of the Esox lucius L.*

Lenght group	n	lx̄	Wx̄	calculated weight	Wg	W%
261,00—300,00	2	278,50	220,00	233,43	−13,43	6,10
301,00—340,00	3	322,66	363,33	366,10	−2,77	0,76
341,00—380,00	13	362,30	561,53	521,74	39,79	7,08
381,00—420,00	15	403,93	758,00	727,99	30,01	3,95
421,00—460,00	8	440,87	935,00	951,38	−16,38	1,75
461,00—500,00	6	486,50	1345,00	1285,16	59,84	4,44
501,00—540,00	—	—	—	—	—	—
541,00—580,00	1	553,00	1770,00	1902,00	−132,48	7,48

According to the formula for *B. bjoerkna* (Tab. 5) log W=3.1854 log 1−4.9752 the smallest deviation was obtained in the length group 141—160 (0.35 g namely 0.36%), whereas the greatest in the group 181—200 (4.87 g namely 2.63%).

Tab. 5. *Real and calculated values of the weight (meadle values for separated length groups) of the Blicca bjoerkna L.*

Length group	n	lx̄	Wx̄	calculated weight	Wg	W%
121,00—140,00	5	132,80	62,00	61,33	0,67	1,08
141,00—160,00	31	152,90	95,80	96,15	−0,35	0,36
161,00—180,00	31	170,40	134,83	135,73	−0,90	0,66
181,00—200,00	19	189,00	183,94	188,81	−4,87	2,63
201,00—220,00	2	206,00	255,00	248,41	6,59	2,58

In *C. auratus gibelio*, (the formula Log W=2.9693 log 1−4.4201), the smallest deviation between measured and calculated body mass was recorded in the length group 181—200 (0.41 g namely 0.18%, Tab. 6), whereas the greatest in the group 121—140 (7.72 g namely 9.65%).

Tab. 6. *Real and calculated values of the weight (meadle values for separated length groups) of the Carassius auratus gibelio Bloch.*

Length group	n	lx̄	Wx	calculated weight	Wg	W%
101,00—120,00	1	120,00	60,00	56,67	3,33	5,55
121,00—140,00	1	139,00	80,00	87,72	−7,72	9,65
141,00—160,00	8	155,75	122,25	122,96	−0,71	0,58
161,00—180,00	25	174,40	181,99	172,02	9,97	5,47
181,00—200,00	37	188,97	218,64	218,23	0,41	0,18
201,00—220,00	15	211,53	307,33	305,07	2,26	0,73
221,00—240,00	9	227,77	375,55	379,95	−4,40	1,17
241,00—260,00	3	243,33	436,66	462,32	−25,66	5,87
261,00—280,00	1	270,00	660,00	629,73	30,27	4,58

Conclusion

On the basis of the investigations on the correlation between length and body mass, as well as fattening and allometric ratio of length to body mass in *E. lucius, B. bjoerkna,* and *C. auratus gibelio,* the following conclusions are drown:

Positive and highly significant correlation coefficients of the three species under investigation were obtained.

With respect to age, correlation coefficients of *E. lucius* and *B. bjoerkna* tend to increase, whereas in *C. auratus gibelio* it stagnates.

Fattening coefficient of the three species point to satisfactory fattening.

Differences between measured and calculated body mass in certain length groups fall within tolerant ranges.

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A Tisza folyó Esox Lucius L., Blicca bjoerkna L. és Carassius auratus gibelio Bloch fajainak testhossz- és testtömeg dinamikája

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Kivonat

A szerzők az 1979—81 között begyűjtött anyag alapján a 2+ -os—5+-os fejlődési csoportba tartozó *E. lucius, B. bjoerkna* és *C. auratus gibelio* testhossz- és testtömeg arányait vizsgálták. Az említett testméretek közötti korreláció pozitív és magasan szignifikáns értékű. A korrelációs koefficiens az *E. lucius*-nál 0,8671—0,9732, a *B. bjoerkna*-nál 0,9215—0,9621 és a *C. auratus gibelio* esetében 0,9572—0,9250. A tápláltság koeficiense az *E. lucius*-nál a legalacsonyabb, a *C. auratus gibelio*-nál pedig a legmagasabb értékeket mutatja. Az egyes korcsoportok lemért és számított testhossz- és testtömeg alometriás arányainak értéke az *E. lucius*-nál 0,76—7,48%, a *B. bjoerkna*-nál 0,36—2,63% és a *C. auratus gibelio*-nál 0,18—9,65%.

Динамика продольного роста и массы Esox lucius L., Blicca bjoerkna L. и Carassius auratus gibelio Bloc в Тисе

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Резюме

На основании материала собранного в периоде 1979—1981 г. исследовано соотношение продолыного роста и массы *E. lucius, B. bjoerkna* и *C. auratus gibelio* в возрасте 2+ до 5+. Корреляция между стандартным продолыным ростом и массы тела положительна и имеет большое значение. Коеффициент корреляции у *E. lucius* от 0,8671 до 0,9732, у *B. bjoerkna* от 0,9215 до 0,9621 и у *C. auratus gibelio* от 0,9572 до 0,9250. Коэффициент откормленности меньше всех у *E. lucius* затем у *B. bjoerkna*' а больше все у *C. auratus gibelio*. Вычислением алометрических соотношений продолыного роста и массы разницы между взвешенными и вычисленными значениями для массы определённой продольной группы составляют для *E. lucius* от 0,76—7,48%, *B. bjoerkna* от 0,36—2,63% и для *C. auratus gibelio* от 0,18—9,65%.

Dinamika dužinskog rasta i mase Esox lucius L., Blicca bjoerkna L. i Carassius auratus gibelio Bloch u Tisi

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Abstrakt

Na osnovu materijala sakupljenog u periodu 1979—1981. g. ispitivan je odnos dužine i mase *E. lucius, B. bjoerkna* i *C. auratus gibelio* uzrasta od 2+ do 5+. Korelacija izmedu standardne dužine i mase tela je pozitivna i visoko značajna. Koeficijent korelacije se krece kod *E. lucius* od 0,8671 do 0,9732, kod *B. bjoerkna* od 0,9215 do 0,9621 i kod *C. auratus gibelio* od 0,9572 do 0,9250. Koeficijent uhranjenosti je najmanji kod *E. lucius*, zatim kod *B. bjoerkna*, a najveci kod *C. auratus gibelio*. Izračunavanjem alometrijskih nosa dužine i mase tela razlike izmedu izmerenih i izračunatih vrednosti za masu za odredene dužinske grupe su za *E. lucius* od 0,76—7,48%, *B. bjoerkna* od 0,36—2,63% i za *C. auratus gibelio* od 0,18—9,65%.

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NEW MEMBER IN THE FISH FAUNA OF THE RIVER TISZA: THE BALON STICKLEBACK (GIMNOCEPHALUS BALONI HOLČIK ET HENSEL 1974)

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(Received February 15, 1983)

Abstract

This short publication reports on the newer place of occurrence of the Balon stickleback *(Gymnocephalus baloni)*, the latest species of the *Gymnocephalus (=Acerina)* genus described by HOLČIK and HENSEL (1974). The new species — demonstrated by the describers from the area of Czechoslovakia and Roumania — was first found in Hungary in the Danube (BOTTA, KERESZTESSY, PINTÉR — manuscript), and shortly later it also appeared in the river Tisza (Tiszafüred, October 17, 1981).

A review is given of the external species features on the basis of which the sample from the river Tisza was identified, and on the basis of which, respectively, the new species can be distinguished from its nearest relative, the ruff *(Acerina cernua)* (Fig. 1).

The experiences gained so far show that the Balon stickleback — contrary to the ruff — is a rheophyl species having solitary habitude, developing by way of ecological isolation.

Owing to the small size and rareness, the new fish species in the river Tisza has no economical significance.

The Balon stickleback *(Gymnocephalus (=Acerina) baloni)* was described by HOLČIK and HENSEL from the Czechoslovakian reach of the Danube (HOLČIK and HENSEL 1974). Authors mention that the figure of the species had occurred also earlier in the special literature, thus for example, in the works of ANTIPA (1909), BERG (1949) and BĂNĂRESCU (1964) the picture of this species can be seen as the ruff *(Acerina cernua)*. The describers of the new species have also demonstrated it from the Roumanian reach of the Danube — examining the earlier collections of museum material. Since the Hungarian reach of the Danube lies between the Czechoslovakian and Roumanian reaches, it was expectable that the species manifests itself in Hungary, too (PINTÉR 1978).

The first Hungarian samples were collected by BOTTA, KERESZTESSY and NEMÉNYI on October 14, 1981 from the Danube at the border of the village Gerjen, and in the following year, they were also successful in finding the species in other sections of the river. The collected individuals were taken to the aquarium of the zoo in Budapest for further studying, and this is where author had the opportunity to observe them in the August of 1982. On this occasion, author had notified István Botta, the director of the aquarium, that the new species is also present in the river Tisza, as he had caught one from the Tisza at Tiszafüred on October 17, 1981. This was then thought by author to be a variant of the ruff, nevertheless, the prepared colour slides of it also made possible the exact determination.

On the basis of the new species' original description obtained in the meantime,

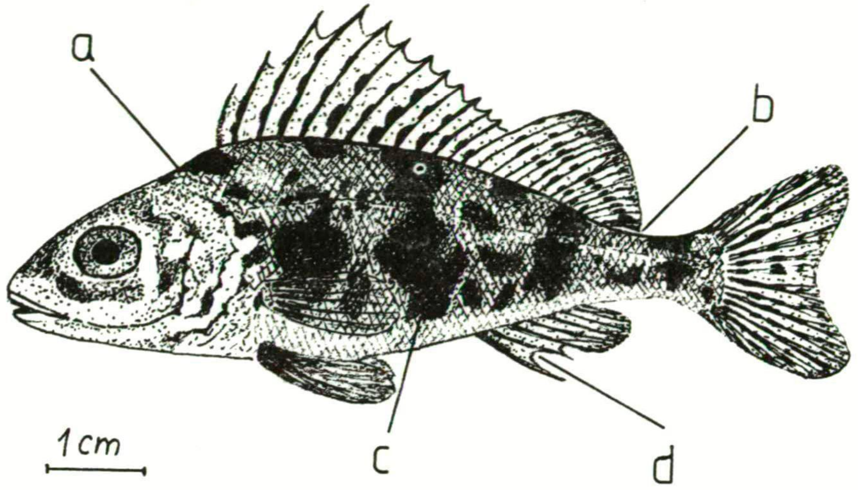

Fig. 1. Sample of the Balon stickleback (*Gymnocephalus baloni* HOLČIK et HENSEL 1974) originating from the river Tisza. External characteristics: the contour of the spine is more highly arched (a), the contour of the posterior dorsal fin's arch almost perpendicularly intersects the contour of the tail (b), the spine and flank shaft are speckled by large, dark brown spots (c), the fin membrane of the anal fin is deeply intersected (d).

it became unambiguously proved that the sample caught from the Tisza — thought earlier by author to be a variant — is identical with the fish species described by HOLĈIK and HENSEL under the name of *Gymnocephalus baloni;* therefore the new fish species is a member of the Tisza's fauna. This is further strengthened by the fact that meanwhile, it has also turned up from one of the regions of the Tisza — the Laskó brook flowing into the Tisza at the village Sarud — (October 18, 1982) (BOTTA, KERESZTESSY, PINTÉR — manuscript).

The describers have found characteristic osteological differences between the two closely related stickleback species, however, their differentiation is also possible on the basis of the external morphological features.

The Balon stickleback's spine is slightly more arched than that of the ruff, thus in this regard of its stature it is more similar to the perch *(Perca fluviatilis)*. On its spine and flank — contrary to the sporadical, small spots of the ruff — larger, dark brown, irregular shaped spots are detectable. These may even blend into transverse stripes, nevertheless, the striation in such case is not as definite as for example in the case of the perch. There are also differences observable in the shape of the fins regarding the two stickleback species. While in the case of ruff the contour of the dorsal fin's arch, supported by the soft fin-rays, reaches the tail by a sharp angle; in the shaft case of the Balon stickleback this angle is close to 90° — in the latter, the fin membrane stretching between the firm rays of the anal fin is also deeply intersected (Fig. 1).

According to describers, the Balon stickleback and the ruff developed as the result of ecological specialization, and their differing environmental demands are also supported by the new species' places of occurrence observed in Hungary so far. The ruff favours backwaters, channels and the slow river reaches, while the Balon stickleback more likely lives in waters of stronger current; thus being more similar in this regard to the *Acerina schraetzer*.

In connection with its ethology, the aquarium observations show that it is a solitary species. Contrary to the ruff — it does not gather into schools, and — also in contrast to the ruff being active in the daytime, too — it only leaves its hiding place at sunset (BOTTA, KERESZTESSY, PINTÉR — manuscript).

Due to the smallness and rarity of the fish fauna's new member in the river Tisza, it has no economical significance.

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A Tisza folyó halfaunájának új tagja: Balon durbincs (Gymnocephalus baloni Holčik et Hensel 1974)

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Kivonat

A rövid közlemény a *Gymnocephalus (=Acerina)* genus HOLČIK és HENSEL (1974) által leírt legújabb fajának, a Balon durbincsnak *(Gymnocephalus baloni)* újabb lelőhelyéről számol be. Az új fajt, amelyet leíróinak Csehszlovákia és Románia területéről sikerült kimutatniuk, Magyarországon először a Dunában találták meg (*Botta, Keresztessy, Pintér* — kézirat), s röviddel ezután a Tiszából is előkerült (Tiszafüred, 1981. október 17.).

A dolgozat bemutatja azokat a külső faji bélyegeket, amelyek alapján a tiszai példány azonosítása történt, illetve amelyek alapján a vágó durbincstól *(Acerina cernua)* megkülönböztethető.

A Balon durbincs — ellentétben a vágó durbinccsal — soliter életmódot folytató reofil faj, amely ökológiai izolációval alakult ki.

A Tisza új halfajának kis mérete és ritkasága következtében gazdasági jelentősége nincs.

Новый член рыбной фауны реки Тисы: ёрш Balon (Gymnocephalus baloni Holčike tHensel 1974)

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Резюме

Краткое сообщение даёт отчёт о новом местонахождении ерша Balon — новейшего вида *Gymnocephalus (=Acerina)* genus, описанного в 1974. г. Холщиком и Хеншелем. Этот новый вид, найденный ими на территории Чехословакии и Румынии, в Венгрии впервые удалось обнаружить в Дунае (Ботта, Керестеши, Пинтер — рукопись), а вскоре и в Тисе (Тисафюред, 17-го октября 1981 г.).

Работа описывает те внешние признаки вида, на основании которых провели опознание

найденного в Тисе вида, то есть на основе которых его можно отличить от режущего ерша — *(Acerina cernua)*.

Ерш *Balon*, в отличие от режущего ерша, — реофильный вид, ведущий солитёрный образ жизни, появившиейся в ходе экологической изоляции.

Новый вид рыбы Тисы вследствие мелкого размера и редкого появления не имеет экономического значения.

Novi član ihtiofaune reke Tise: Gymnocephalus baloni Holčik et Hensel, 1974.

HARKA Á.

Gimnazija „Kossuth Lajos", Tiszafüred

Abstrakt

U ovom kratkom saopštenju daje se prikaz novog nalaza *Gymnocephalus baloni* HOLČIK et HENSEL. 1974, najnovije vrste roda *Gymnocephalus (=Acerina)*. Autori su novu vrstu opisali iz Čehoslovačke i Rumunije. U Madjarskoj su prvi put registrovali u Dunavu (BOTTA, KERESZTESSY, PINTÉR — rukopis), a nedugo zatim javjla se i nalaz u Tisi (Tiszafüred, 17. okt. 1981).

U radu su prikazani oni karakteri po kojima je primerak iz Tise identifikovan, odnosno po kojima se ova vrsta razlikuje od *Acerina cernua.*

Gymnocephalus baloni nasuprot *Acerina cernua* je solitarno reofilna vrsta i nastala je ekološkom izolacijom.

Ova nova vrsta u ihtiofauni reke Tise nema privrednog značaja, kako zbog malih dimenzija, tako i kao retka vrsta.

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NICHE STUDIES IN THE STOCK OF STARLING (STURNUS V. VULGARIS L. 1758)

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Abstract

Author took stock of the nesting starling pairs in a marked section of the Tisza flood-plain between the period of 1978 and 1981. During the course of the observations the question arose whether there are any competitions in this habit between the starling and the tree-sparrow, also in hollow nestling there. Surveying was accomplished in case of both species regarding four niche dimensions: diameter of hollow-opening, height of hollow, volume of animal nutriment, and the time passing between feedings. From the data, the niche width and the niche overlapping were calculated, the latter also being controlled with the help of a method using computer. Despite the significant overlapping, no competition could be detected between the two species. The environmental capacity of the flood-plain forest is so great that the populations of the two species are kept well.

Introduction

Measurements were carried out between 1978 and 1981 concerning the nesting stock of starlings at the 3400 m long, 20—250 m wide flood-plain of the Tisza between Szeged-Tápé and Vesszős (Fig. 1). The plant-associations of the area are shown on Figure 2. It is characteristic that the area in under water periodically, generally from March to July, when for shorter-longer periods water overlaps the flood-plain. The starlings feeding their youngs bring the food to their nests in the forest from the agricultural fields. The nest settlements are in every case joined by a meadow-like region where the food can be obtained (COLEMAN 1972, MOEED 1976). Thus, author was able to count the birds coming in to feed and flying out to obtain food in his district, and concluded the number of nesting pairs (MOLNÁR 1980 — Table 1). In the studied flood-plain forest four, well-separable starling-colonies were observed (Fig. 1 — colonies are labelled by Roman numerals). For better reviewing the two larger nest settlements (I and IV) were divided into 2—2 parts. During the surveying of the colonies it was detectable that after the starling, the most frequently occurring bird nesting in hollow is the tree sparrow, the hatching period of which is also in conformity with that of the starling. The question arose whether there is any competition between the two species; since this has been observed between starling and Greatspotted Woodpecker (CERVA 1930), starling and Syrian woodpecker (SZLIVKA 1957), starling and stock dore (VARGA 1978). Therefore surveying was carried out in case of both species in four niche dimensions: diameter of hollow-opening; height of hollow; volume of animal nutriment, and period between feedings (Tables 2—5). The niche overlapping and niche width were calculated from the obtained data.

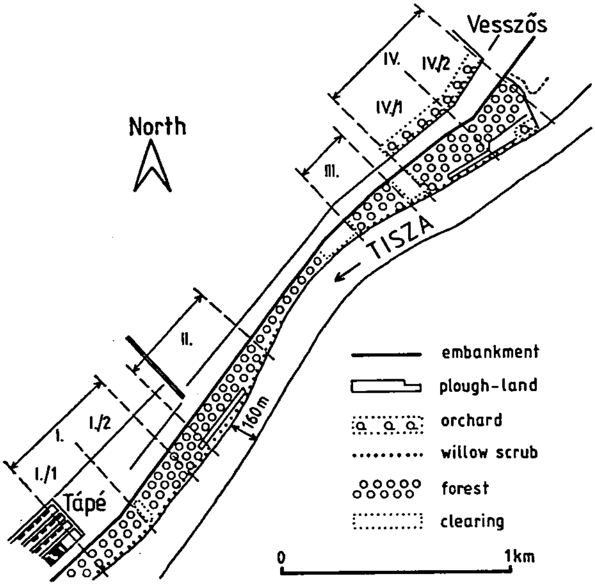


Fig. 1. The section of the Tisza flood-plain at Tápé-Vesszős and the location (I—IV) of the starling-colonies in the gallery forest.

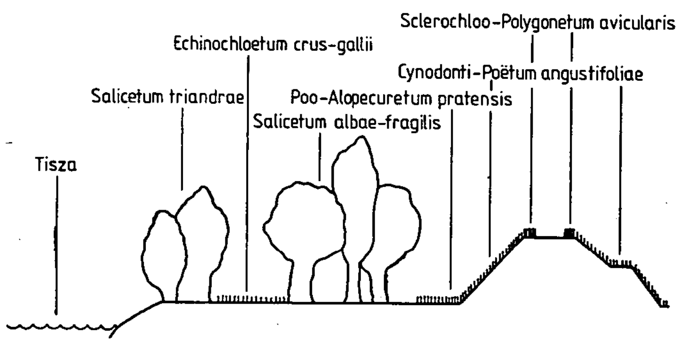


Fig.2. The plant-associations of the gallery forest at the Tisza flood-plain (according to BODROGKÖZY).

Methods

When making observations with binoculars weekly, author counted the feeding starlings from the top of the embankment, at well separable 300—400 m long sections. The number of nesting pairs (n) was calculated from the formula

$$n=\frac{x_{3t}}{t}$$

where x stands for the number of times the birds flew in within 3t time, and t being the average of the period between feedings. For starlings, t=3,66 minutes; for tree-sparrows, t=2,66 minutes.

The periods of feedings were measured with chronometer. the diameters of hollow-openings with sliding caliper, the height of hollows with measuring rod. The volume of animal nutriment was gathered from the literature (PAPP 1943, MÓCZÁR 1969, RÉKÁSI 1970, 1975, 1978, 1980, MAGYAR 1973, 1976, 1981, SZIJJ 1957).

The following methods of evaluation were applied for the niche studies: the niche overlapping was determined with the help of the Renkonen-index:

$$C_{ih} = 1 - 0{,}5 \sum_j (P_{ij} - P_{hj})$$

where C_{ih} means the niche overlapping between the species of the i and h orders. P_{ij} is the relative frequency of the species of the i order in given j resource state, P_{hj} is the relative frequency of the species of the h order in the same condition.

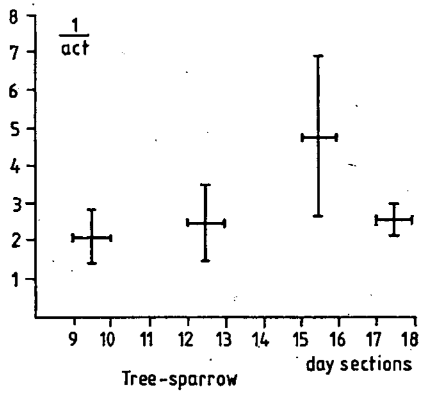
The multi-dimensional niche overlapping was calculated on the basis of GALLÉ's method (unpublished) with the help of a computer, where the P_i values are the elements of an n-dimensional matrix — obtained by the Descartes-series of the individual niche dimensions.

The niche width was calculated by the formula of Shannon—Weaver:

$$H(S) = -\sum_i p_i \ln p_i$$

Results

The stock of nesting starlings in the studied floodplain sections was surveyed in 1978, 1980 and 1981 (Table 1). The number of hatching pairs varied annually. The



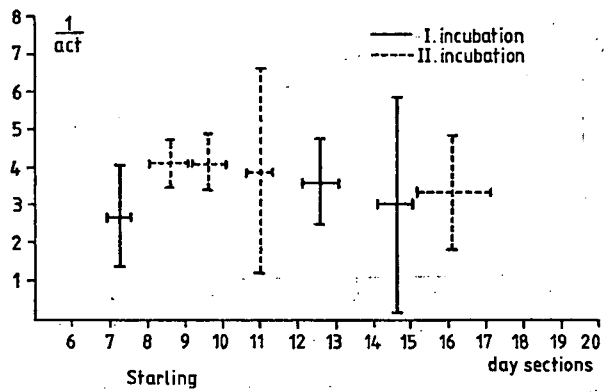


Fig. 3—4. Part-day activity of alimentation of the tree-sparrow and starling.

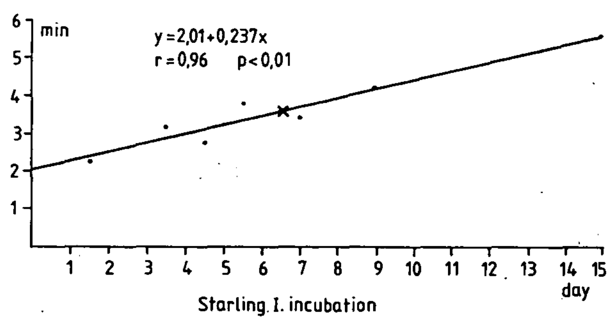
pairs of the second hatching were also surveyed in 1981, in which case 55,5% of the pairs took part compared to the first one (Table 1). With the advancing of the youth rearing the earlier nesting pairs have their youngs leave the nest, therefore the number of feeding pairs gradually decreases (Table I, on the right of the dotted line). The number of tree-sparrows nesting in the area is 45% that of the starling pairs.

The following conclusions could be drawn from the niche analysis:

the values of the niche width (Table 6) show that the starlings make use of the resources in a wider province than the tree-sparrows.

The niche overlapping is of significant degree, the value being around 0,5 (Table 6). Nevertheless, in practice, author did not observe situations referring to competition, which gave rise to the problem that the representation of the dimensions in coordinate system shows a greater overlapping than in reality (Figs. 7—10). Therefore, with a multivariable method (GALLÉ 1981) the complete data was computerized, thus the value of the niche overlapping came to 0,2428. The overlapping, however, does not also mean competition. The resources of the flood-plain are so abundant that they would be capable of keeping even much larger populations of the two species.

The overlappings are well observable on the graphs of the four niche provinces Figs. 7—10). A few consequences, however, could further be drawn from these. In



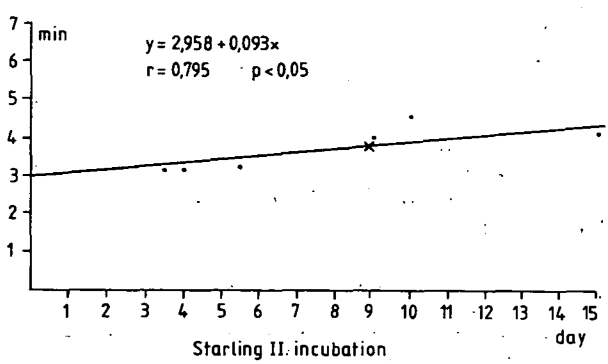


Fig. 5—6. Illustrations of feeding time of the starling's first and second incubation, regarding the advance in youth rearing.

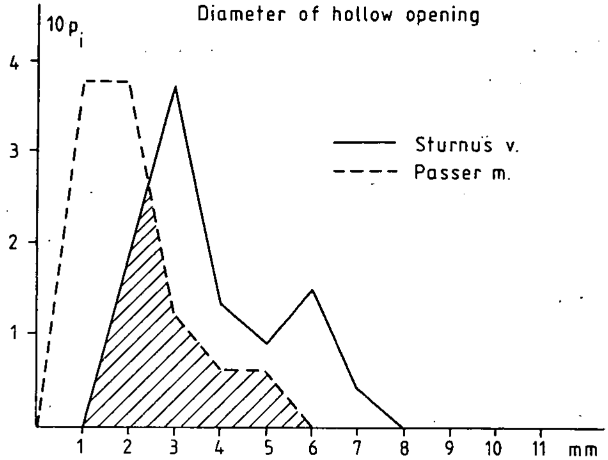


Fig. 7

Fig. 7—10.: Demonstration of overlappings regarding the diameter of hollow-opening, height owl hollow, volume of animal nutriment and feeding times in the case of starling.

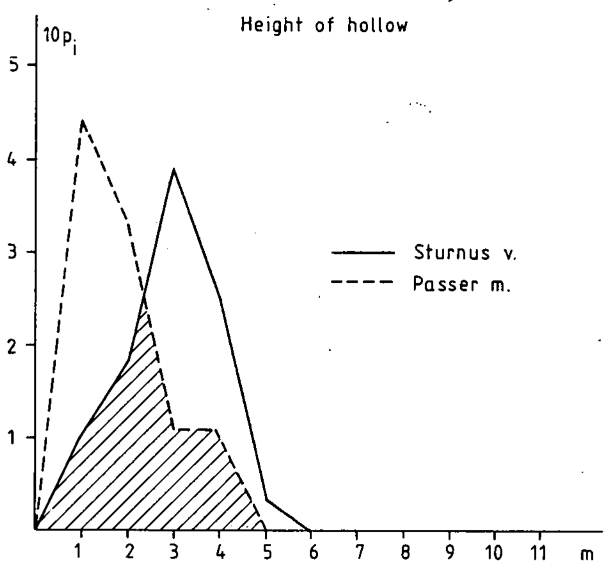


Fig. 8

every case, the graph line of the tree-sparrows comprehends smaller provinces on the horizontal axis than that of the starlings, and it reaches higher vertically.

Therefore, the tree-sparrow consumes less animal nutriment, feeds more frequently, and has its nest lower, in a hollow with smaller opening than the starling. These facts may probably be in relationship with the differences in body size of the two species.

The registration of feeding times made it possible to illustrate in co-ordinate system the part-day activity of the two species (Figs. 3 and 4), as well as the frequency of feeding related to the age of the young birds, too (Figs. 5 and 6). In the case of starlings, it can be seen from the significant data of both the first and second incubation that with the advance of youth rearing the time elapsing between feedings becomes longer progressively, thus as the young birds grow, their parents feed them rarer. According to the measurings of GYÜRKÓ (1959) this is also the case regarding hei treesparrow. These data can also be comprehended as the studies of a fifth niche-da mension.

The starling and the tree-sparrow are species occurring in large numbers in the living place of the flood-plain. It is characteristic that their reproduction cycle takes place in the gallery forest, but they obtain their insect aliment from the joining agicultural fields and meadows. Their consumption of insects is considerable in this period, therefore the individuals of the populations of these two species are the significant consumers of the flood-plain—agricultural field ecosystem. The biocenoses of the living-space at the Tisza river are not known well enough as yet, therefore it is important to study the structure of the animal cenoses — for example that of the bird populations — in this ecosystem, too.

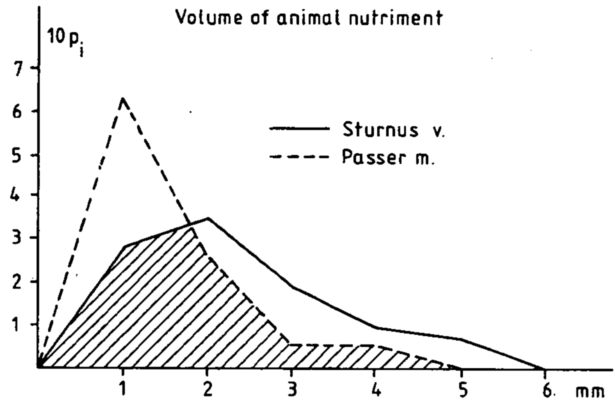


Fig. 9

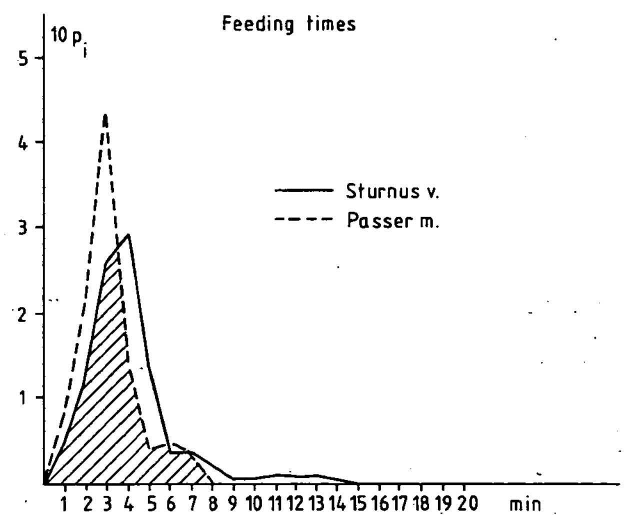


Fig. 10

Table 1. *The stock of nesting starlings at Tápé—Vesszős between 1978 and 1981. On the right of dotted line: with the advancing of youth rearing the pairs of the colonies have their youths fly out of the nests (1978).*

Numbering of populations	Year	1978 pairs	1980 pairs	1981 pairs of I. incubation	1981 pairs of II. incubation	1978		
						20. V.	25. V.	31. V.
I.	I./1	10	26	16	12	15	12	4
	I./2	5	6	9	2			
II.	II.	6	6	6	3	6	5	2
III.	III.	5	4	7	1	5	5	0
IV.	IV./1	35	10	16	8	53	25	2
	IV./2	18	9	9	7			
Total number of pairs		79	61	63	35	79	47	8
Percental ratio		—	—	100%	55,5%	100%	59,5%	10,1%

Table 2—5. *Data of measurements concerning the diameter of hollow-opening, height of hollow, volume of animal nutriment and feeding times related to starling and tree-sparrow.*

Volume of animal nutriment

	Serial number Millimetres	1 0—10	2 11—20	3 21—30	4 31—40	5 41—50	6 51—60	7 61—70	8 71—80	9 81—90	10 91—100	11 101—110	12 111—120
S_1	Sturnus vulgaris	12	15	8	4	3	0	0	0	0	0	0	1
S_2	Passer montanus	12	5	1	1	0	0	0	0	0	0	0	0

Feeding times

	Serial number Minutes	1 0—1	2 1—2	3 2—3	4 3—4	5 4—5	6 5—6	7 6—7	8 7—9	9 8—9	10 9—10	11 10—11	12 11—12	13 12—13	14 13—14	15 14—15	16 15—16	17 16—17	18 17—18	19 18—19	20 19—20
S_1	Sturnus v.	13	34	74	83	38	10	11	5	2	2	3	1	1	2	0	0	1	0	0	1
S_2	Passer m.	7	18	36	12	3	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 6. *Values of niche width and niche overlapping in case of starling and tree-sparrow.*

	Niche width H (S)		Niche overlapping
	Sturnus v.	Passer m.	C_{in}
Diameter of hollow opening	1,731	1,340	0,424
Height of hollow	1,494	1,214	0,508
Feeding times	1,905	1,563	0,685
Volume of animal nutriments	1,525	0,947	0,648

Values of four-factoral niche width and niche overlapping

Diameter of hollow-openings

	Serial number / Millimetres	1 / 21—30	2 / 31—40	3 / 41—50	4 / 51—60	5 / 61—70	6 / 71—80	7 / 81—90	8 / 91—100	9 / 101—110	10 / 111—120	11 / 121—130
S_1	Sturnus vulgaris	0	8	17	6	4	7	2	0	0	1	1
S_2	Passer montanus	6	6	2	1	1	0	0	0	0	0	0

Height of hollows

	Serial number / Metres	1 / 1—2	2 / 2—3	3 / 3—4	4 / 4—5	5 / 5—6	6 / 6—7	7 / 7—8	8 / 8—9	9 / 9—10	10 / 10—11	11 / 11—12
S_1	Sturnus vulgaris	3	5	11	7	1	0	0	0	0	0	1
S_2	Passer montanus	4	3	1	1	0	0	0	0	0	0	0

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Niche vizsgálatok seregély (Sturnus v. vulgaris L. 1758) állományban

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Kivonat

A Tisza hullámterének egy kijelölt szakaszán mérte fel a szerző a fészkelő seregélypárok számát 1978—1981 közt. A megfigyelések közben felvetődött a kérdés, hogy van-e ebben a habitatban kompetíció a szintén odufészkelő mezei veréb és a seregély között? Négy niche dimenzióban — az odunyílás átmérője, az odu magassága, az állati táplálék nagysága, az etetések közt eltelt idő — végzett felméréseket mindkét fajnál. Az adatokból a niche-szélességet és a niche átfedést számította, utóbbit egy számítógépes módszerrel is kontrollálta. A jelentős átfedés ellenére nincs kompetíció a két faj között. A hullámtéri erdő környezeti kapacitása olyan nagy, hogy a két faj populációit jól eltartja.

Анализы Niche в составе скворцов (Sturnus v. vulgaris L. 1758)

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Сегед

Резюме

Автор статьи подсчитывал количество гнездящихся на выделенном участке долины Тисы пар скворцов в 1978—1981 гг. В ходе наблюдений возник вопрос о том, существует ли в этом габитате конкуренция между гнездящимися там же полевыми воробьями и скворцами. Для обоих видов были проведены наблюдения в 4 измерениях niche: диаметр дупла, количество животного корма, высота дупла и время между кормлениями. На основе этих данных автор определил niche — ширину и niche — перекрытие, контролируя последний показатель и методом электронно-вычислительного подсчёта. Вопреки значительному перекрытию, между двумя видами нет конкуренции. Лес поймы и окрестности обеспечивают условия существования популяций обоих видов.

Istraživanje ekoloških niša na populaciji čvorka (Sturnus v. vulgaris L. 1758)

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Abstrakt

Autor je u periodu 1978—1981. godine vršio utvrdjivanje broja parova čvoraka na odredjenoj deonici plavne zone reke Tise. Tokom osmatranja postavilo se pitanje, postoji li u ovom habitatu kompeticija izmedju čvorka i poljskog vrapca, koji je takodje dupljarica?

Ispitivanjem za obe vrste bile su obuhvaćene četiri niše: prečnik ulaznog otvora duplje, visina na kojoj se nalazi duplja, veličina plena, interval izmedju dva hranjenja. Na osnovu dobijenih podataka računskim putem utvrdjena je veličina i preklapanje niša. Preklapanje niša je prekontrolisano pomoću kompjutera. Konstatovano je da se ni pored značajnih preklapanja na javlja kompeticija izmedju ovih vrsta. Kapacitet sredine plavnog područja obezbedjuje opstanak populacija obe vrste.

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KCALORY DEMAND OF THE HERON COLONIES IN THE HUNGARIAN TISZA-VALLEY

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Abstract

A significant number of *Ardea cinerea, Ardea purpurea, Egretta alba, Egretta garzetta, Ardeola ralloides, Nycticorax nycticorax* and *Platalea leucorodia* nest in the Hungarian region of the Tisza river. The present paper studies the aliment demand of the larger colonies of these species, and determines that from Spring to Autumn (210 days) the 9407 kg biomass of the herons consumes 251 110 kg aliment equivalent to 430 104 megacalories, being exclusively from animal nutriments.

Introduction

The gallery forests in the valley of the Tisza are particularly suitable for the settling of herons nesting on trees, and their dense colonies represent a singificant biomass. Their alimentation raises practical problems from the viewpoint of nature conservancy and economy. On the one part, the numerical demand of this high-numbered heron type should be evaluated in regard to the nutriment chain; on the other part their fish consumption means competition in the utilization of fishing and angling at the district. The intake of animal food in the largest amount is by the herons in the flood-plain. The results of VASVÁRI's and STERBETZ's analysis on the alimentation of the Hungarian herons are summarized in detail in the hand-books by BAUER—GLUTZ (1966) and CRAMP—SIMMONS (1977), therefore — regarding the prescribed length — this paer only comprises the studies on the amount of Kcalories taken up by the herons from Spring to Autumn from the flood plain.

Materials and Methods

On the basis of author's own studies and the publications by RADVÁNYI (1951), SZIJJ (1951), KOVÁCS (1968), LŐRINCZ (1975), MOLNÁR (1977), LŐRINCZ (1979), BALOGH—ZÁKÁNY (1980), OKTH (1981), BALOGH (1982), MOLNÁR (1982), KOVÁCS (1983) from the interval between 1948—1983, the average number of nests of the large heron colonies at the Tisza-valley was taken as the starting source (Table 1). According to his mortality studies carried out in 24 incubation seasons, author averagely counted with 3 raised up nestlings from the *Ardea* and *Egretta;* 4 from the *Ardeola;* and 2 from the *Nycticorax* and *Platalea* species. From the 7 species 135 stomach contents were at disposal, partly from the collection of the Ornithological Institute, partly using up the perished individuals found at the nest colonies. Due to nature conservancy reasons a larger amount of study material could not be collected (Table 2—3). The data on the weight of the collected individuals were used for the calculation of the biomass. Table 4. shows the biomass and the daily aliment weight. For the calculation of the Kcalory values of the aliment groups, the starch-value tables by HEROLD (1977) were used (Table 5—6), giving the final results in megacalory to avoid the big numbers (1 kg starch-value = 2356 Kcalory = 2.356 megacalory). The biomass-value applied for the calculations only reflects the facts in the good alimentary relations of the years abounding in water. In the dry years, after leaving the nests, the majority of the herons wander far. The ecological relations of the Tisza II. Storage Tank's gigantic establishment have become permanently favourable, therefore the Summer scattering of the water birds is always significantly less there.

Results

The following aliment-types were found from the studied stomach contents:

Mammalia: *Microtus arvalis, Arvicola terrestria, Apodemus* sp., *Sorex* sp.

Reptilia: *Natrix* sp (10—20 cm), *Lacerta* sp.

Amphibia: *Bombina bombina, Rana* sp. *Hyla arborea.*

Pisces: *Acerina cernua* (10 cm), *Misgurnus fossilis* (10 cm), *Cyprinus carpio* (5—20 cm), *Tinca tinca* (5—10 cm), *Alburnus alburnus* (5—8 cm), *Rutilus rutilus* (6—7 cm), *Rhodeus sericeus* (2—3 cm), *Carassius carassius* (8—12 cm), *Esox lucius* (10—15 cm), *Silurus glanis* (10—20 cm), Pisces sp.

Gastropoda: *Lithoglyphus nacticoides, Succinea* sp., *Valvata piscinalis, Planorbiss* p., *Gastropoda* sp.

Insecta: *Naucoris cimicoides, Ranatra* sp., *Notonecta glauca, Nepa rubra, Berosus spinosus, Hydrophilidae* sp., *Ditiscus marginalis, Cybister* sp., *Cicindela* sp.; *Odonata larvae, Gryllotalpa vulgaris, Libellula* sp., Insecta sp.

Crustacea: *Cammarus* sp., *Triops* sp., Crustacea sp.

From the listed species the heron colonies of the Tisza-valley take in an average of 1196 kg-s daily. In adult individuals the daily amount of nutriment corresponds to 16% of their body weight. The pullus individuals consume nutriment corresponding to 40—50% of their body weight at start. This amount decreases in proportion with their growth, reaching the value determined for adults in September. Therefore, in the case of juvenile individuals, 20% of their body weight was taken as an average. Junor (1972) also obtained results similar to author's determinations, when studying piscivorous birds.

The daily 12 quintal animal organism forming the nutriment of the herons is a highly significant amount in the trade in materials of the ecosystem. From economical point of view the prey of the Micromammalia means profit, the consumption of fish is partly nourishment competition with man. It is striking that in the flood plain the herons mostly consume fry. They only prey larger fish from the artificial fish-ponds, where the possibility of choice is minimal.

Table 1. *Average number of nests regarding the studied heron colonies.*

Heron colony (Period)	*Ardea cinerea*	*Ardea purpurea*	*Egretta alba*	*Egretta garzetta*	*Ardeola ralloides*	*Nycticorax nycticorax*	*Platalea leucorodia*
Sasér (1948—83)	55	—	—	55	21	92	—
Labodár (1968—83)	53	—	—	23	10	90	1
Environment Protection Area of the Middle Tisza (1949—82)	42	—	—	40	15	150	—
Bird Reserve at Tiszafüred (1980—83)	144	50	100	120	80	2000	270
Ároktő (1964—65)	100	—	—	50	15	100	—
Leninváros (1982)	82	—	—	—	—	—	—
Tiszaluc (1951—79)	40	50	—	15	15	170	—
Total	516	100	100	303	156	2602	271

Table 2. *Distribution of stomach content according to the areas of collection.*

Species	Hódmező vásárhely	Labodár (Csongrád)	Tiszafüred	Total
Ardea cinerea	10	5	4	19
Ardea purpurea	5	1	2	8
Egretta alba			3	3
Egretta garzetta	29		1	30
Ardeola ralloides	25			25
Nycticorax nycticorax	37		7	44
Platalea leucorodia		4	2	6
Total	106	10	19	135

Table 3. *Distribution in time of the collected stomach contents.*

Month	*Ardea cinerea*	*Ardea purpurea*	*Egretta alba*	*Egretta garzetta*	*Ardeola ralloides*	*Nicticorax nycticorax*	*Platalea leucorodia*
IV			2	3	1		
V	3	1		1	1	1	2
VI	5	2	1	8	7	10	4
VII		2		8	8	18	
VIII	7	2		6	7	8	
IX	4	1		4	1	7	
Total	19	8	3	30	25	44	6

Table 4. *Basis of calculation concerning biomass and weight of nutriment.*

Species	Adult.		Juv.	
	Weight of of ind	Weight of daily aliment	Weight of ind.	Weight of daily aliment
Ardea cinerea	1500	240	800	160
Ardea purpurea	1200	190	750	120
Egretta alba	1700	270	900	140
Egretta garzetta	500	80	370	50
Ardeola ralloides	300	40	200	30
Nycticorax nycticorax	450	70	300	50
Platalea leucorodia	1900	300	900	140

Table 5. *Percental distribution of aliment types.*

Type of aliment	*Ardea cinerea*	*Ardea purpurea*	*Egretta alba*	*Egretta garzetta*	*Ardeola ralloides*	*Nycticorax nycticorax*	*Platalea leucorodia*
Mammalia	18	23	10	2	2	8	—
Reptilia	—	—	—	—	2	8	
Amphibia	7	12	—	7	18	33	18
Pisces	39	18	30	31	17	17	27
Gastropoda	—	—	—	11	6	—	—
Insecta	36	47	60	47	48	34	55
Crustacea	—	—	—	2	7	—	—

Table 6. *Nutriment taken between the period III. 1—IX. 5.*

Group of aliment	Weight of aliment (kg)	Megacalory
Mammalia	27 412	54 895
Reptilia	3 890	2 933
Amphibia	41 894	67 117
Pisces	71 802	152 247
Gastropoda	1 667	2 258
Insecta	103 846	149 243
Crustacea	599	1 411
Total:	251 110	430 104

Conclusions

The process of the anthropogenic transformation of the Tisza basin pauperizes in general the alimentation areas of the water birds. At the same time, the great water storage tanks established in this area provide abundant and select nutriment for the birds. Therefore, the heron colonies scattered at the Tisza flood plain gradually move to such artificial environment, having permanent favourable ecological fundamentals. This tendency is already becoming strikingly evident in the environs of Tiszafüred, and its increase is expectable in the future. This concentration of the Tisza's ecosystem is advantageous, since the huge storage tanks are more easily able to serve the high aliment demand of the heron species than the rest of the river sections.

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A magyarországi Tisza-völgy gémtelepeinek Kcaloria-igénye

STERBETZ I.

Kivonat

A Tisza magyarországi szakaszán jelentős mennyiségű *Ardea cinerea, Ardea purpurea, Egretta alba, Egretta garzetta, Ardeola ralloides, Nycticorax nycticorax* és *Platalea leucorodia* fészkel. A dolgozat e fajok nagyobb kolóniáinak táplálékigényét vizsgálja. Megállapítja, hogy a gémek 9407 kg. biomasszája tavasztól őszig (210 nap) kizárólag állati tápláléknemekből 430 104 megacaloriának megfelelő, 251 110 kg táplálékot fogyaszt. A folyó mentén épülő nagy víztárolók fokozatosan környezetükbe vonzzák a hullámtérben elszórt gémtelepeket, mivel ökológiai viszonyaik állandósultan kedvezők. Ez a tendencia Tiszafüred környékén máris feltűnően megnyilvánul s fokozódása a jövőtől várható.

Калорийная потребность журавлиной коллонии в долине Тисы, находящейся на территории Венгрии

И. Штербец

Резюме

В находящейся на территории Венгрии долине Тисы гнездится значительное количество *Ardea cinerea, Ardea purpurea, Egretta alba, Egretta garzetta, Ardeola ralloides, Nycticorax nycticorax, Platalea leurorodia.*

Работа исследует потребность в пище более крупных колоний этих видов. Установлено, что журавлям для накопления биомассы в 9407 кг от весны до осени (210 дней) потребовалось 251 110 кг животной пищи, что соответствовало 430 104 мега кал.

Строящиеся вдоль реки водохранилища постоянно концентрируют вокруг себя разрозненные журавлиные колонии, поскольку обеспечивают выровненно благоприятные экологические условия.

Эта тенденция ярко проявляется в окрестностях Тисафюред и в дальнейшем ожидается её усиление.

Potreba kilo-kalorija kolonije čaplji doline reke Tise u Madjarskoj

STERBETZ I.

Abstrakt

Duž reke Tise u Madjarskoj gnezdi se značajan broj Ardea cinerea, Ardea purpurea, Egretta alba, E. garzetta, Ardeola ralloides, Nycticorax nycticorax i Platalea leucorodia. U radu su obuhvaćena istraživanja potrebe hrane većih kolonija. Utvrdjeno je da za stvaranje 9407 kg. biomase, čaplje, koje od proleća do jeseni (210 dana) isključivo troše životinjsku hranu, utroše 251 110 kg. hrane, odnosno 430 104 megakaloriju. Velika akumulaciona jezera, izgradjena duž reka, sa povoljnim ekološkim uslovima, postepeno privlače rasute kolonije čaplji sa plavnih zona. U okolini Tiszafüred-a ova je pojava očigledna, i u buduće se očekuje njeno intenziviranje.

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THE MIGRANT MOLLUSC (DREISSENA POLYMORPHA PALL.) AS THE ALIMENT OF NATATORIAL BIRDS AT THE TISZA-VALLEY

I. STERBETZ

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Abstract

A report is given on the studies regarding the occurrence of the Dreissena polymorpha on the basis of 386 stomach contents of 27 natatorial-merganser and diver bird species at the Tisza-valley. Table 1. comprises the results from which it could be determined that the *Dreissena* has dominant role in the alimentation of the species belonging to the *Gavia*, *Aythya*, *Bucephala* and *Mergus* genera wintering at the Tisza river. The fluctuation of occurrence and quantity relations of mollusca is also reflected from the Winter dynamism of the aquatic birds feeding from it. The evaluation of this process could be utilized in practice as an environment-protection indicator.

Introduction

The praeglacial spreading of the Dreissena polymyorpha endemically populated enormous areas from the Azov-sea to western Europe, but the later glacial periods eliminated the European stock. Nevertheless, starting from the XVIII. century, partly through natural expansion, and partly through importation, it vigorously began to spread towards the West and during the course of 160 years, its fossil spreading was reconstructed here in about 35% (THIENEMANN 1950, STANCZYKOWSKA 1963, ZIELCH—JACCKEL 1965, NOWAK 1977).

Its dynamic expansion also displayed effect on the areal changes of some aquatic birds. Firstly the Northern natatorial birds, also wintering in Central Europe, took advantage of this characteristic aliment-prosperity (OLNEY 1963, GÉRUDET 1968, LEUZINGER 1969).

According to authors knowledge no evaluation has been achieved as yet regarding the dynamism at the Tisza-valley of the migrant mollusc. Author has been carrying out ornithoecological studies continuously since 1947 at this area, during the course of which the striking progression of the Dreissena was experienced after 1951, which phenomenon gradually diminished after 1970. Up to now it is unclear whether this could be explained by natural or anthropogenic effects. In greater quantities the migrant mollusc occurs in insular zones at the live and dead channels of the Tisza river. In the Winter periods these centres particularly attract the Northern aquatic birds assembling at this area. It seemed likely that the abundance in nutriment from migrant mollusca gave rise to this bird concentration. The study demonstrated in this paper was carried out to clarify this.

Materials and Methods

The following material was at disposal from the collection of the stomach contents from the Institute of Ornithology and the authors own collection from the period between 1947—1983: Live and dead channel from the river section at Algyő — Csongrád:

Gavia arctica 2, *Podiceps ruficollis* 5, *Podiceps nigricollis* 4, *Podiceps cristatus* 23, *Podiceps griseigena* 1, *Anser albifrons* 6, *Anser fabalis* 4, *Anas platyrhynchos* 219, *Anas querquedula* 15, *Anas crecca* 23, *Anas acuta* 5, *Anas strepera* 4, *Anas clypeata* 2, *Aythya ferina* 6, *Aythya fuligula* 11, *Aythya nyroca* 31, *Aythya marila* 1, *Bucephala clangula* 6, *Mergus albellus* 3, *Mergus mersanger* 1, *Mergus serrator* 1.

Backwater at Szolnok: *Anser fabalis* 2.

Area of the live and dead Tisza at Tiszasüly: *Gavia stellata* 1, *Gavia arctica* 1, *Tadorna tadorna* 1, *Aythya ferina* 1, *Clangula hyemalis* 1, *Melanitta fusca* 1.

Live Tisza and water storage tank at Tiszafüred: *Gavia stellata* 1, *Bucephala clangula* 2, *Melanitta nigra* 1.

The stomach content analysis regarding the significant proportion of the listed material has been discussed in detail in the publications cited (Sterbetz 1967, 1969, 1969a, 1973, Kiss—Sterbetz 1973, Sterbetz 1975, 1983). Therefore, Table 1 only demonstrates the analysis of occurrence and amount of the *Dreissena* from the period of the whole year. Migrant mollusca only exclusively occurred between the period of October — February in the bird stomach contents from the area of the Tisza river.

Results

It was evident from the analysis of the 386 stomach contents of the 27 natatorial bird species collected from the Algyő-Tiszafüred section of the Tisza river that from the species in question, 14 consumed migrant mollusca. From these, in the case of 11 species, this type of nutriment occurred with a frequency of 90—100%!

Dreissena was not present in the case of the *Podiceps, Anser, Branta, Tadorna* genera. From the *Anas* genus only the *A. platyrhynchos* consumed a non-significant amount of migrant mollusc. The *Aythya ferina, Aythya fuligula* and *Bucephala clangula* regularly wintered at the place where the migrant mollusc was present in concentrated form. The *Gavia, Aythya, Clangula, Melanitta* and *Mergus* species characteristic of the marine or oligotrophic deep waters are relatively rare in Eastern Hungary. Their regular occurrence demonstrated at the Tisza river is also explained by the *Dreissena* found from their studied stomach contents. Their average quantity relations from the period between 1947—1982 is demonstrated on Table 2, from the Algyő—Csongrád section.

Conclusions

The spreading and mass ratio of the migrant mollusc showed sensitive fluctuation during the course of the recent years as the consequence of increasing water contamination. This fluctuation also exerts considerable influence on the Winter occurrence at the Tisza river and the period of duration of the Northern natatorial birds feeding from them and being characteristic of the marine or oligotrophic deep waters, therefore, continuous studies on their dynamisms may also be utilized as an environment-protection indicator.

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Table 1. *The occurrence of Dreissena polymorpha in the stomach contents of aquatic birds studied at the area of the Hungarian Tisza-valley*

Studied bird species	Ind. No.	No. of cases in wich *Dreissena* occurred	Amount of Dreissena (pieces)
Gavia stellata	2	2	2
Gavia arctica	3	3	19
Podiceps ruficollis	5	—	—
Podiceps nigricollis	4	—	—
Podiceps cristatus	23	—	—
Podiceps griseigena	1	—	—
Anser albifrons	6	—	—
Anser fabalis	6	—	—
Branta leucopsis	1	—	—
Tadorna tadorna	1	—	—
Anas platyrhynchos	219	4	12
Anas querquedula	15	—	—
Anas crecca	23	—	—
Anas acuta	5	—	—
Anas strepera	4	—	—
Anas clypeata	2	—	—
Aythya ferina	7	4	57
Aythya fuligula	11	10	140
Aythya nyroca	31	3	3
Aythya marila	1	1	39
Bucephala clangula	8	7	37
Clangula hyemalis	1	1	2
Melanitta nigra	1	1	22
Melanitta fusca	1	1	12
Mergus albellus	3	3	12
Mergus merganser	1	1	1
Mergus serrator	1	1	2

Table 2. *Average individual number of Winter aquatic birds regularly consuming Dreissena polymorpha from the Algyő—Csongrád section of the Tisza river between the period 1947—1982 (+ = marine, or oligotrophic deep water species)*

Bird species	X.	XI.	XII.	I.	II.
+ *Gavia stellata*	6	5	2	1	2
+ *Gavia arctica*	10	8	6	2	4
Aythya ferina	450	120	10	8	300
+ *Aythya fuligula*	220	280	300	200	400
Aythya nyroca	60	—	—	—	10
+ *Aythya marila*	4	2	1	—	—
+ *Bucephala clangula*	80	250	500	400	450
+ *Clangula hyemalis*	1	—	1	—	—
+ *Melanitta nigra*	—	2	—	1	—
+ *Melanitta fusca*	—	3	2	—	—
+ *Mergus albellus*	10	40	150	90	20
+ *Mergus merganser*	2	6	22	30	20
+ *Mergus serrator*	1	2	1	2	1

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A vándorkagyló (Dreissena polymorpha Pall.) mint a Tisza-völgy úszó madarainak tápláléka

STERBETZ I.

Kivonat

A dolgozat a Tisza völgyéből 27 úszó-bukó és búvár madárfaj 386 gyomortartalmából vizsgálja a *Dreissena polymorpha* előfordulásokat. Az 1. táblázatban ismerteti annak eredményeit. Megállapítja, hogy a Tiszán telelő *Gavia, Aythya, Bucephala, Clangula* és *Mergus* genusokba tartozó fajok táplálkozásában a *Dreissenána*k kiemelt szerepe van.

A *Dreissena* elterjedési és tömegviszonyai a fokozódó vízszennyeződés következtében az utóbbi években érzékenyen fluktuálnak. Ez az ingadozás a belőlük táplálkozó marin és oligotróf mélyvizekre jellemző északi vízimadarak tiszai, téli előfordulását és itt tartózkodásuknak időtartamát is befolyásolja. Ennek az értékelése a gyakorlatban környezetvédelmi indikátorként hasznosítható.

Моллюск-путешественник (Dreissena polymorpha Pall.) как пища для плавающих птиц долины Тисы

И. Штербец

Резюме

Работа исследует места появления *Dreissena polymorpha* на основе анализа содержания 386 желудков плавающе-ныряющих и ныряющих птиц (27 видов). Таблица 1 приводит результаты исследований. Автор установил, что в питании видов, относящихся к зимующим на Тисе *Gavia, Aythya, Bucephala, Clangula* и *Mergus*, особое значение имеет *Dreissena.*

Распространение и массовое появление *Dreissena* в силу усиливающегося загрязнения воды в последние годы чувствительно флуктирует. Эти колебания оказывают влияние на частоту появления на Тисе зимой и на длительность нахождения здесь северных водных птиц, характерных для мариновых и олиготрофных глубоких вод. Выяснение этого может служить на практике индикатором степени загрязнённости воды.

Dreissena polymorpha Pall. u ishrani ptica plovuša reke Tise

STERBETZ I.

Istraživačka grupa reke Tise, Szeged

Abstrakt

U radu su prikazani rezultati analize 386 želudaca ptica plovuša i gnjuraca, pripadnika 27 vrsta, iz doline reke Tise, na prisustvo *Dreissena polymorpha* (Tab. 1.). Utvrdjeno je da Dreissena polymorpha ima značajnu ulogu u ishrani rodova *Cavia, Aythya, Bucephala, Clangula* i *Mergus,* koji zimuju duž reke Tise.

Rasprostranjenje i koncentracija Dreissena zadnjih godina pokazuje osetne fluktuacije usled zagadjivanja vode. Ova kolebanja utiču na pojavu i dužinu zadržavanja ptica severnih krajevasa marinskih i oligotrofnih dubinskih voda, na reci Tisi. Rezultati ove analize u praksi mogu poslužiti kao indikator u zaštiti životne sredine.

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SPECTROGRAM ANALYSIS OF DIFFERENT CALLS AT THE HERONRY OF LABODÁR

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Abstract

The gargling call of night herons which is audible only during the nesting period in the heronry of Labodár was identified as an "advertising" call and was differentiated by sonogramms from other bird calls occuring in the heronry.

Introduction

In the last six years I investigated the different calls of night herons *(Nycticorax nycticorax)* grey herons *(Ardea cinerea)* and little egret's *(Egretta garzetta)* at the heronry of Labodár, which is situated 55 km-s north from Szeged on a dead arm of the Tisza river.

The results of the first two years were published in a previous paper (WOLLEMANN 1980). In this paper a special nesting call of the night heron was described, which can be imitated as "wawawa" or "lalala".

According to NIETHAMMER (1966) and STEINFATT (1934) the call is a greeting call of the bird arriving at the nest which follows after "guok guok" or "guark guark" and expresses tenderness accompanied by mutual preening. In our cases we were not able to observe the pair greeting function of this call. We classified it rather as an "advertisement" or "parade" call similar to that described by VOISIN (1979) and CHAPPUIS (1979) in the little egret as a long gargling advertising call used by the males to attract females. Noble et als (1938) attributed a "snap-hiss" ceremony to the lonely standing male black-crowned night heron *(Nycticorax nycticorax hoactli)* attracting females which corresponds to the function of the gargling call we observed in night herons. In addition they described also an "overture and display" behaviour accompanied with mutual guttural greeting calls by males and females, which is not further detailed. One other call is described as recognition call "krwawrk-krwawrk-krwawrk", which helps the retention of the group.

The main purpose of our recent investigations was therefore to establish whether the gargling night heron call is a pair greeting or an advertising pair forming call.

Methods

Night heron calls were recorded at the heronry from April till June (1978—1983). A Grundig C 200 automatic tape recorder was used at 19 cm/min speed with a cardioide dynamic microphone cable transformator Type MKT—1H, AEG.

A Sound Spectrograph Series 700 model (voice identification Inc.) was used to prepare spectrograms with a frequency response of 85—8000 Hz as described previously (Wollemann and Olaszy 1977). One spectrogram displayed 2.4 sed of sound.

Results

In order to distinguish between the different bird calls I collected samples not only from the previously published "lalala" night heron (Fig. 1) call (Wollemann 1980) but beside other night heron calls "guok" (Fig. 2) and "guark" (Fig. 2) adult grey heron call frarnk (Fig. 3) and young grey heron calls (kak kak) (Fig. 4) and little egret call (kark) (Fig. 5) were also recorded and analysed. No gargling call of little egrets was observed probably owing to the small number of pairs (3—14) in the colony, whereas night herons and grey herons were present in a consistently large number (30—68 pairs resp. 20—30 pairs).

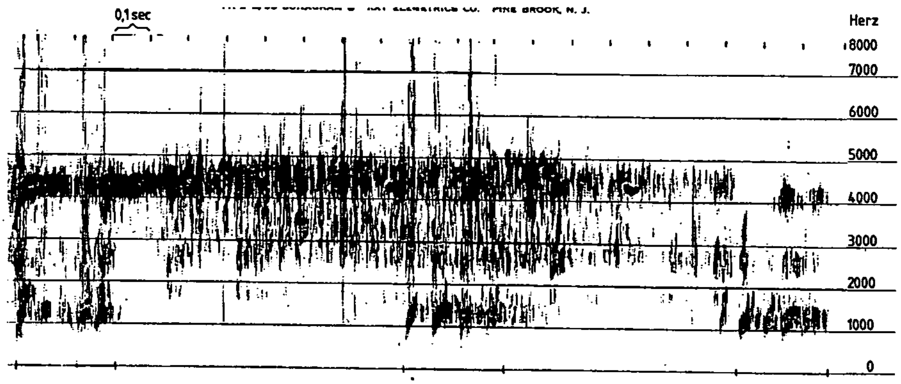

Fig. 1. "lalala" call of night heron: |——|. The recordings over 2000 Herz are background voices 1

The frequency of the night heron advertising call "lalala" was as previously described between 500—1500 Herz and was repeated four times within 0.4 sec with an average of 4—5/min during one hour observation time. The distribution of the calls was clusterlike, one call induced frequently an other bird's call. In the observed cases the single birds were usually standing on a tree branch, some times over a nest and night herons standing also alone on other branches started to call after a while too. Some of the birds, sitting already on nests did not answer. As the night heron

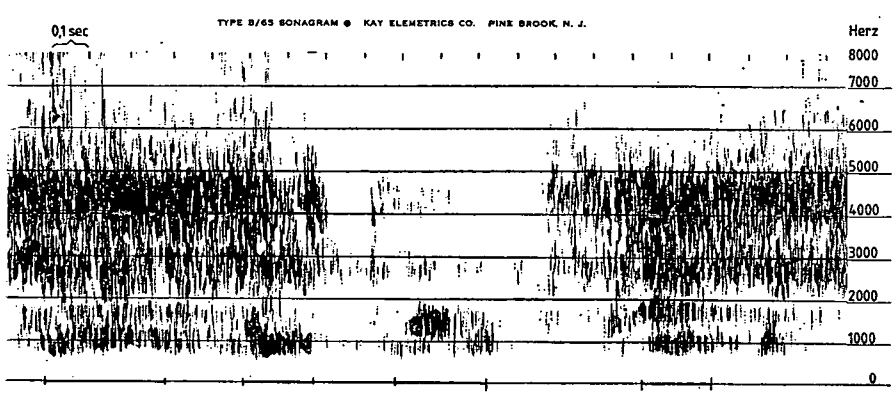

Fig. 2. "quok" |——| and guark: |—| call of night heron.

males and females are alike it is not possible to tell something about the sex of the calling bird from their appearance. The advertising call was not used by the night herons flying into the heronry as a greeting call and could be easily differentiated in the sonogram from other night heron (Fig. 2), grey heron (Fig. 3—4) and little egret (Fig. 5) calls.

In table I we summarized the occurrence of the night heron advertising call (Table 1).

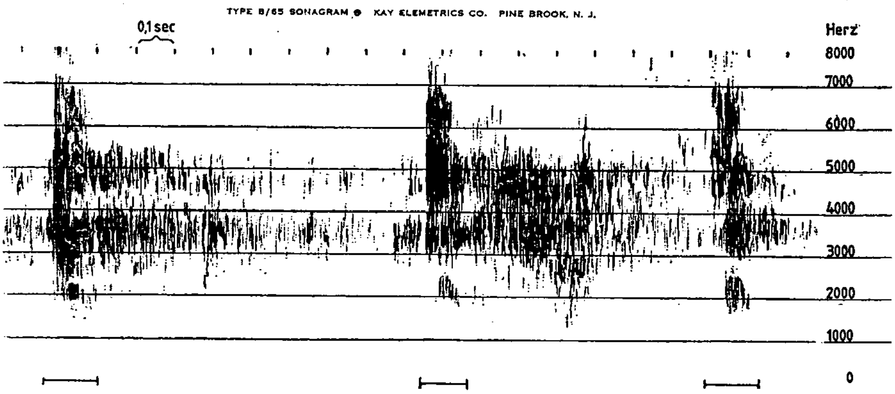

Fig. 3. "frarnk" calls of grey heron: |——| .

Table 1. *Data concerning the occurrence of night heron advertising calls from 1978 to 1983.*

	1978	1979	1980	1981	1982	1983
3. 11.		—				
3. 25.		—				
3. 31.		—				
4. 2.	—					
4. 4.			—			
4. 15.		+				
4. 22.	+	++				
4. 29.	++					—
4. 30.		++				
5. 4.			–			
5. 5.		++				
5. 13.		+				
5. 15.	–N					++
5. 20.		+				
5. 28.	–N					
5. 31.				++		
6. 4.	++N					
6. 6.		–N			—	—
6. 10.	+					
6. 17.	+N					
6. 19.						–N
6. 24.	–N	–N				

\+ = call present
— = call absent
N = Nestling calls

Discussion

Analysing the data of STEINFATT (1934) his earliest observation days on the Little Balaton were as follows: June 5 (1931), June 1 (1932), May 8 (1933). He mentions also that around the middle of May there are young night herons almost on every place. At his observation place they were 25 pairs of night herons, 4 pairs of grey herons, 4 pairs of squacco herons and 4 pairs of glossy ibis. There were no little egrets, so their voice could not interfere with night herons.

My earliest observations of the "lalala" night heron call were on April 16 (1979) and latest on June (1978) after which no calls could be observed, although the later was a result of a second breeding periods (Table I). The call's advertising function was established by direct visual observations. No nest greating ceremony was observed, in contrary gargling calls were observed only from lonely night herons. The late occurrence of the call in 1978 (first decade of June) was probably connected with the nest robberies of grey hooded crows, since many eggshells were found on the dike (WOLLEMANN 1980).

We conclude therefore that the "lalala" call is identical in function with the "advertisement" or "parade" call of the little egret which is described by VOISIN (1979) as follows below "Donc, ..." (p. 411). The physical parameters of the two

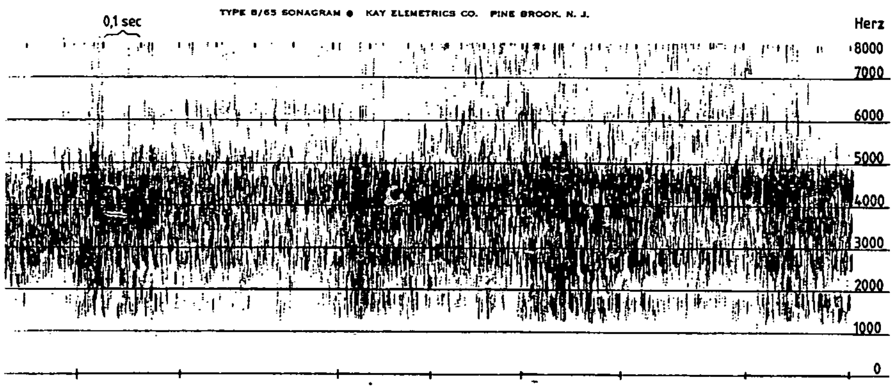

Fig. 4. "kak" calls of young night herons in colony: |——|.

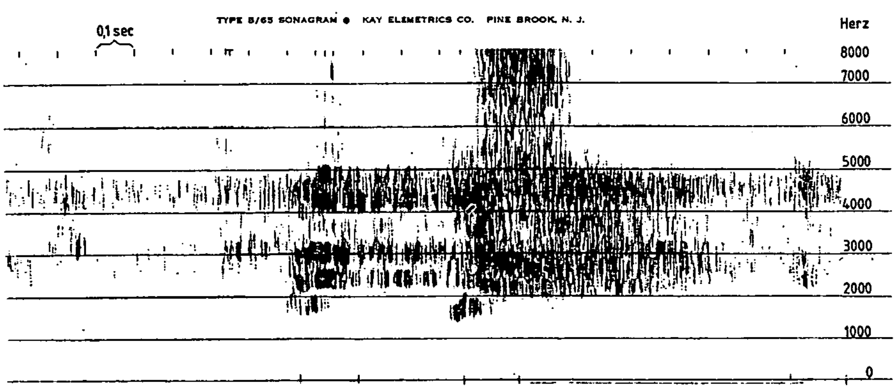

Fig. 5. "kark" calls of little egret in colony: |——|.

calls are also similar: one parade call is repeated 4—6 times during 0.4 sec. in the little egret compared with 3—4 times during 0.4 sec in the night heron. The main difference is reflected in the frequency: the former call is between 500—6000 Herz, whereas the later between 500—1500 Herz.

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A labodári gémtelep különböző hangjainak spektrogram analízise

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Kivonat

A régebbi kutatásaimhoz képest megállapítottam, hogy bakcsónál a csak fészkelési időben hallható „LALALA" hangok ellentétben az irodalommal, az általam észlelt valamennyi esetben parádé vagy hirdetési (advertisement-call) hang jellegűek és nem párköszöntőek.

Ugyanakkor a telepen előforduló más madaraktól ilyen hangot nem észleltem, amit szonogram felvételekkel alátámasztottam.

Спектрограммный анализ различных звуков, издаваемых Биохимический журавлями в колонии в Лабодаре

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Резюме

В отличие от своих прежних исследований, установила, что в противоположность литературным данным, издаваемые кваквой только в период закладки гнёзд звуки «ЛАЛАЛА» во всех наблюдаемых мною случаях носили парадный или «информационный» (advertisement-call) характер, а не характер приветствия супружеской пары.

В то же время другие живущие в колонии птицы подобных звуков не издавали, что подтверждается сонограммными записями.

* Donc á ce stade de recherche de partenaire, l'oiseau emploie ce cri „gargarisé": 1) lorsqu'i parade, en alternance avec la posture d'appel; 2) entre les périodes de parades un rien suffit a provoquer ce cri de facon plus ou moins sonore.

STEINFATT, O.: (1934) Ein Beitrag zur Kenntnis der Naturgeschichte, insbesondere des Brutlebens des Nachtreihers. — Beitr. Fortpfl. Biol. *10*, 85—96.

Spektrogramska analiza glasovnih efekata kolonije čaplji Labodár-a

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Abstrakt

U odnosu na naša ranija istraživanja utvrdili smo, da se kod gaka oglašavanje sa „LALALA" javlja samo u doba gneždjenja. Suprotno literaturnim podacima, ono ne predstavlja dozivanje parova, već je u svim slučajevima našeg osmatranja paradnog značenja (advertisement-call). Sonogramski snimci potvrdajuju da za ostale ptice kolonije ovo oglašavanje nije utvrdjeno.

Sonogramska ispitivanja oglašavanja ptica u koloniji čaplji Labodár

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Abstrakt

Ispitivano je oglašavanje gaka *(Nycticorax nycticorax)* sonogramom (usporeni magnetofonski snimak), i to oni glasovni efekti koji se javljaju samo u doba gneždjenja. Smatramo da je ovo oglašavanje signalnog ili „paradnog" karaktera. Ovi glasovni efekti gaka jasno se izdvajaju na snimku, od oglašavanja drugih ptica.

Tiscia (Szeged) Vol. XIX, pp. 211—219 (1984)

FROM THE LIFE OF THE TISZA-RESEARCH WORKING COMMITTEE, WHICH HAS BECOME INTERNATIONAL

Tisza-Research Conference XIV (1983)

Compiled by

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As in the previous years, the Conference took place in the site of the Hungarian Academy of Sciences' Committee at Szeged, on April 28—29, 1983. Apart from the Hungarian co-workers, Soviet and Yugoslavian members were also participants on the event. During the course of the 2 days 22 reports were delivered, followed by discussions. A round table conference was also organized to co-ordinate the researches of complex nature.

In his presidential opening address GY. BODROGKÖZY spoke highly of the activities the retired Professor L. MÓCZÁR, honorary chairman, had exerted in the life of the Working Committee, expressing thanks to him for his kind efforts. He congratulated Professor I. BENEDECZKY, the new Professor and Head of the Zoology Department of the University, on the occasion of his election to honorary chairman.

The thirty years of the researches at the Tisza-valley

The research of the Tisza-valley has arrived to its 30th anniversary. During the course of these three decades, the research working process — which has become realized, or is before comming so by means of the moral and financial support of the Hungarian Academy of Sciences, the Ministry for Cultural Affairs, and the National Water Conservancy Office — could be divided into four periods.

Through the programme of the first period, the institution of the processing of the area became possible. This field-work tock place in terms of the vegetation-survey at the Hungarian lower region of the Tisza flood-plain, at the beginning of the 50s. The geobotanic co-workers participating in this survey had determined on map-sheets the range of the natural and cultivated plant communities occurring at the given area, from Szolnok to Szeged. Although unfortunately this mapping has not been published to this day, the changes which had taken place at the processed area are well followable, and are therefore utilizable. This vegetation-mapping activity practically formed the core of the further increasingly expanding research programmes of the Tisza-valley.

The second period started in the second half of the 50s, when the studies were set on more expansive grounds. With the leadership of Professor G. Kolosváry and the support of the Water Conservancy Directorates, research expeditions began extending to the complete Hungarian section of the Tisza river. Water chemists, hydrobiologists, botanists, as well as zoologists could all obtain review on the living-world and environmental-biological relations of the Tisza-valley.

The idea arose to issue a special periodical for solving the problems of publishing the essays prepared throughout the years. Under the editorship of KOLOSVÁRY—BODROGKÖZY—HORVÁTH, the first volume of the Tiscia was published in the year 1965. From this time, the papers about the Tisza-valley and its environs could appear in a separate publication series. Until now, 18 volumes have been put into the circulation of the international exchange of publications.

The third research period of the Tisza-valley commenced at the end of the 60s, when the management of the Working Committee was taken over by Professor I. HORVÁTH. The Tisza sections suitable for complex biocenological researches were determined during the course of his functioning; thus the registration of the living world at the area of the Kisköre Water Storage Tank for the succeeding generations, before inundation period. The continuous studying of the water at the filled up storage tank and its environment was accomplished with the collaboration of the co-workers of the Tisza II. water conservancy laboratory.

The realization of the research programme regarding the designated section of the Environment Protection Area at Mártély also fell to this period. The field activities were greatly facilitated by the operation of the research house and research motor-boat established on the site.

During the course of the 70s the researches at the Tisza-valley took on an international character. The Uzsgorod State University's biologists joined the studies at the Upper-Tisza region, and the biologists of the Novi-Sad University joined those at the lower region. Lectures are held by them regularly on the occasion of our annualy organized conferences. The leading professors of these Universities are members of both the Executive Committee of the Tisza-Research Working Committee and the Editorial Board of the Tiscia.

The fourth period started in the 80s through my assignment as acting chairman. Utilizing the competition prizes from the Hungarian Academy of Sciences, the Ministry of Cultural Affairs, and the National Office for Environment and Nature Protection, biocenological environmental-biological complex seasonal-dynamic researches are being carried out at four parts of the Hungarian Tisza section. Parallel with the objectives having pronouncedly theoretical nature, we wish to continue giving assistance to the nature- and environment protection; the cultivation of forests and meadows, as well as to other provinces of practice.

Research activities of such purpose are being carried out in the area of the Kisköre Water Storage Tank, at the site of the planned Tisza III. Storage Tank in the environs of Csongrád, and joined to this, at the marshland and environs at Tőserdő of the Kiskunság National Park, as well as at other sections of the river. Researches have also started at the area of Tokaj in connection with the environment and nature protection of Tisza-Bodrogzug.

Joined to these, studies with similar programme are also performed at the Soviet and Yugoslavian regions of the Tisza. 60 Hungarian, 6 Soviet and 10 Yugoslavian researchers of the Tisza-valley Research Working Committee work at the listed areas, who are the co-workers or pensioners of Universities, Colleges, Water Conservancy organs, Museums, Nature and Environment Protection Agencies, as well as Technical- and Secondary Schools. The Working Committee does not have any full-time co-workers.

The presidential address was followed by the secretary's report given by GY.

CSIZMAZIA, which is published as a separate part. In the fore-going brief summaries are given of the lectures delivered during the course of the two days:

I. Preliminary investigations at the area of Tőserdő belonging to the Kiskunság National Park and at the Alpár basin

FEKETE, E.:
Studies on the heavy metals having effect on the water biocenosis in the backwaters at Lakitelek and Alpár

The heavy metals showing effect on the equatic living world were determined monthly during the course of 1982 in the backwaters at Lakitelek and Alpár. The studies were aimed at the determination of the waters' copper-, cadmium-, zinc-, chromium-, and mercury-contents. On the basis of the obtained data image is given of the seasonal changes and the possibilities of certain contamination sources, respectively, observed at the two backwaters.

KOVÁCS, KATALIN and DOBLER, ENIKŐ
Studies on the qualitative and quantitative composition and seasonal changes of phytoplankton at three sampling sites of the dead-Tisza at Lakitelek

Phytoplankton studies were carried out at three sampling sites of the dead-Tisza at Lakitelek, which area is under nature protection. During the processing of the samples taken monthly throughout a year studies extended to the qualitative and quantitative composition, as well as the seasonal changes of the phytoplankton. On the basis of the total algal number the biomass and diversity of phytoplankton was calculated. With the help of cluster analysis answer was seeked for to the question, what similarities are shown in time and space regarding the algal communities at the three sampling areas? In Summer, following the homogeneity of the water areas at Spring, the changes in the phytoplankton composition showed differences at the three sampling sites. In the Autumn and Winter months the connection of the samples from the 2nd and 3rd sampling sites was tight, the phytoplankton composition was similar. The detaching Northern section of the backwater was characterized by plankton communities of varying composition throughout the year.

DOBLER, ENIKŐ and KOVÁCS, KATALIN:
Results of the preliminary studies on the algal communities at the Alpár backwater

The lecture provided a brief summary on the results of studies performed at the backwater between 1976—1980. With these studies the biological water quality of the backwater was determined. At the same time, the seasonal changes characteristic to the zone were also observed on the basis of the algal community compositions. The tendency of the changes was similar in the examined years, at times, however, the effect of the changes in weather (flood, cooler Spring, and colder Winter, respectively) resulted slighter shifts.

In 1982 a more detailed study was started at the Alpár backwater, in the frame of which the composition of phytoplankton was invariably examined to species level. The Czekanowski similarity index was applied for demonstrating the seasonal changes in the algal communities. The phytoplankton diversity of the water area was also studied, using the Shannon-index.

The chlorophyll-a and pheophytin-a concentrations were determined from the monthly taken samples. The aliment supply at the water area was followed with attention by determining the various phosphorus forms. Furthermore, the most essenial chemical studies were also accomplished, limiting to the oxygen circulation and ionic dynamism.

KISS, I.:
Euglena-mass production in the waters of the Alpár basin

From the algological studies of the stagnant waters at the Tisza-valley carried out in the year 1982, the mass production of two *Euglena* species deserves special attention. On August 4, 1982, at the boat-harbour section of the backwater at Tőserdő, the spectacular vegetation colouring of the *Euglena Ehrenbergii;* and on October 24, at the marsh cow-track at Bokros, that of *Euglena sanguinea* was seen. At the Tőserdő backwater the *E. Ehrenbergii* could not be demonstrated at all during the course of the earlier studies carried out throughout the course of several years; and on August 4, its biomass surpassed the total mass of the other algal species. In the cow-track sodificating marsh of Bokros, the shallow water and the base coming to the air were coloured yellowish pale-green by the neuston-like masses of the *E. sanguinea.* During the course of the five decades, this species had only been observed on four occasions in the Hungarian sodic areas, and always in waters polluted by organic matter. The cells of the material found at Bokros were green, and the hematochromic coagulation could only rarely be seen in them. In day-light the effusion of the hematochrome could only be detected after several hours, but even then it did not result the complete red colouring of the cell. On the effect of shade, the clustering of the diffused hematochrome required several hours. This means a significant deviation from the characterization found in the special literature, and it may perhaps be explained by the effect of the strongly alkaline environment (pH 9). However, the existence of biotypic variation may also be assumed.

The two *Euglena* mass productions indicate that the eutrophized site-water also contains amino-acids and biocatalyzers (auxin, vitamin C).

HEGEDŰS, MÁRIA and ZSIGÓ, MARGIT:
Results of the hygienic bacteriological studies at the backwaters of the Tisza river

Samples were taken regularly throughout the course of the past six years from the four backwaters found at the Southern region of the Tisza river.

It has been determined that:

1. The water quality of the backwater at Lakitelek and Alpár was of Ist class "clear" in most of the studied time-points.

2. The hygienic water quality of the backwater at Serházzug was the most unfavourable, of 3rd class, "polluted".

3. On the basis of the results of the hygienic bacteriological studies, the backwater at Atka improved by one category within the last three years.

4. The hygienic water quality parameters were also classified at each water area.

It was established that the study results of the coliform number indicated water quality of Ist class in 17—67%; and on the basis of the values per ml of the total thallus-forming bacteria, the water quality at the studied Tisza backwaters was of Ist class, in 70—100%.

The aim of the studies was to call attention to the preservation of the water at the Tisza backwaters which is favourable regarding quality, even from hygienic point of view.

GÁL, D.:
Seasonal changes in the zooplankton of the Tisza backwater at Alpár

Both in respect to species and individual number, the Rotatoria dominate in the zooplankton of the backwater (cc. 25% Protozoa, 60% Rotatoria, 15% Entomostraca).

Two maximums are observed yearly regarding the total individual number; one in May, the other — somewhat slighter — in September. At the time of the minimum the total individual number is 6—8000 ind/10 l., and at the time of the maximums: 65—80 000 ind/10 l.

The saprobiological quality of the backwater also shows essential changes during the course of the year. The water quality is the best in the Winter — Spring months, when mainly the oligo-, beta-, and beta-mesosaprobic organisms are dominant (saprobity index: 2,0—2,3). Later, during the course of Summer, there is an increase in the beta- and beta-alpha-mesosaprobic organisms, resp. (saprobity index: 2,4—2,7, rarely 2,9).

BÁBA, K.:
Mollusca groups in the area of Tőserdő and Alpár

Studies were continued at two terrestrial forest areas, one at a marsh-forest and one at the Tőserdő backwater, in 100—100 contiguous quadrates with monthly repeats. The biotopes at Tőserdő are under nature protection.

It can be determined that the water fauna of the backwater section utilized for the purposes of bathing and boating shows a 34% impoverishment compared to the studies of the years 1958—60. The distribution of the species is in the form of islands. The drying, filling up and partial lumbering at the fen-wood caused a 90% decrease in species number in the water fauna compared to 1958.

At the willowy-poplar areas and gallery forest, and in the 4 underwood types of the latter, 13 species were manifested, characteristic of the flood-plain forests between the Danube and the Tisza. The development of the species composition is limited by the moisture conditions. With the changes in the moisture condition, on the basis of the monthly samplings, there is also a change in the dominancy values and distribution relations. The changes taking place in the reproduction period and the speed of the ontogenesis of the certain species (steepness of the regression level) play role in the development of the oscillation course.

FARKAS, Á.:
Ichthyological study of the dead-Tisza branch at Tiszaalpár

In 1982 studies were started in the area of Tiszaalpár—Tőserdő. The surveying of the fish fauna was accomplished with the help of 10×10 mm trawl-net, and 50, 29 and 39 mm gill-net. In such way attempt was made to avoid the negative selection.

14 fish species were found in the backwater. The surveys were carried out in May, June and July. The sampling sites were at 3 various places of the backwater.

The 1982 material was made up of 441 individuals. From these, 22 were *Tinca tinca*, 37 were *Amiurus nebulosus*.

On the basis of the surveying it could be determined that while at the lower section of the Tisza the tench and the bullhead pout occurred sporadically, these were relatively frequent in the backwater at Lakitelek.

The rich plant vegetation at the backwater ensures favourable roeing conditions for the species of the Cyprinidae family, at the same time, the muddy section of the riverside sector provides rich aliment sources for the breeding of the progeny.

CSIZMAZIA, GY.:
Preliminary mammological studies at Tőserdő

During the course of the years 1981—1982 (in the Spring of 1982) small mammals were caught by means of surface traps at the biotopes of Tőserdő. The results were compared to the trappings in the year 1968. In contrast to the 24 species trapped and studied in 1968, the presence of 12 species was proved in this period. The data at disposal are suitable for faunistic evaluation. Studies on the space structure of the cenoses were carried out in 1983 by means of live-trapping with the method of capturing, labelling and holding in. Even during the course of the studies and analysis of cast *(Asio otus)* scantiness was evidenced in the small mammal fauna (mainly the *Microtus arvalis* and *Apodemus* sp. occurred in 90%). There was a change in the alimentary habit of the ondatra at this area — it has turned to the increased consumption of mullusc. At the same time, its amount fell back to the quarter.

Therefore, according to the previous studies, a considerable decrease in species number was experienced in the mammal fauna at the Tőserdő region, the cause of which is unknown. The further step in research is the revelation of the competition and predational relations, since these result demographic and selective effects.

VÉGVÁRI, P.:
The role of the River Barrage at Kisköre in the prevention of the extreme water contamination

The River Barrage at Kisköre offers unique possibility for the prevention of the extreme water contaminations. The demonstration of the oxygen uptake of the water led through by upper overturning at the Barrage was given in the lecture. On the basis of the measured data it could be determined that the amount of oxygen led in is considerable even in the case of the relatively great oxygen-saturated arriving water. In the knowledge of the results, such a water quality damage-averting technology was suggested, by which the water contamination causing oxygen deficiency could be successfully avoided.

BANCSI, I.:
The development of the Rotatoria- and Entomostraca fauna in the storage tank at Kisköre

At the area of the Kisköre storage tank, large contiguous water surfaces developed in 1978. On the basis of the data concerning the studies during the course of the last five years an analysis is given of the Rotatoria- and Entomostraca fauna of the smaller units at the storage tank — Abádszalóki-bay, banked up Tisza, Small-Tisza, Sarudi-basin, Poroszlo-basin. The lecture deals with the questions of the population- and alimentary relationships connected to the project regarding the utilization of the storage tank.

KOZMA, A. and TÖLGYESI, GY.:

Mineral substances of the reed-grass vegetation at the Kisköre storage tank

Extending the previous studies at the area of the Kisköre storage tank carried out at the end of June, 1982, 72 plant samples were analysed for 11 chemical elements. Apart from the species of the littoral zone, the retraceable species of *Myriophyllo-Potametum* and *Nymphaeetum albo-lutae* were also evaluated. Comparing the complete vegetation with that in other areas of Hungary, it could be determined that at these areas periodically being inundated with fresh water, as well as in the water of the storage tank itself, as yet there is no such salt accumulation which would cause alarm. At the littoral zone the concentrations of the elements judged as being more critical were as follows: P 2,0 g/kg; Na 0,8 g/kg; Zn 42,6 mg/kg and Cu 7,5 mg/kg. Although the members of the reed-grass communities evidenced outstanding values in respect of sodium, manganese and zinc, this phenomenon can only be led back to the phylogenetically determined biochemical habits, and not to the advanced stage of water contamination.

The lesson from the studies is that the aliment-accumulation dynamic of the terrestrial plants located at the edge of the storage tank and appearing in the form of islands within the storage tank is differing. Therefore, it seems necessary to perform comparative studies with similar methods in the future, at the whole area being under the effect of the water.

KISS, K. T.:

Relationship between the chemical oxygen demand, suspended matter content and algal count in the Eastern Main Canal

The results of the studies performed between 1968—1975 at the section between Tiszalök and Balmazújváros of the Eastern Main Canal demonstrated that depending on the flood at the Tisza river and the water velocity in the Main Canal, the amount of suspended matter changed from 5—6 mg to 500—700 mg, the value of the chemical oxygen demand (COD_{sMn}) ranged between 3—15 mg, and the algal count varied from 30—50 thousand to 15—20 million ind/l.

The lecture reported on the degree to which the COD values were determined by the suspended matter content and the algal count, respectively. Carrying out path-analysis, it could be determined that in the case of high suspended matter content — when algal count is low — the COD is determined by the amount of suspended matter in 40—70%, and by the algal count ni 0,5—0,6%. Besides low suspended matter content — when algal count is high — the values of the COD are determined in 4—10% by the amount of suspended matter content, and in 15—21% by the algal count.

BODROGKÖZY, GY.:

Hydroecological species-component analyses in protection-embankment grass communities

(The manuscript of the lecture will appear in the 1984 volume of the Tiscia.)

GASKÓ, B.:

The main groups of the Cerambycides living in the flood-plains of the Tisza and Maros rivers

At the flood-plains of the Tisza and the Maros rivers in Csongrád county the *Salicetum alba-fragilis* and the *Salicetum triandrae* communities are dominating, together with various culture consociations.

Since the plant inhibitors of the *Salix alba* mean an exhaustive factor in some cases, with all probability the polyphage, and not the stenoc oligophage species are settled here. The properly so-called xilophage group can be divided further to forest and forest-steppe elements. Those long-horned beetles can be listed to the latter group, which do not further belong to the forest biocenosis as imagos. Their common characteristic is that more or less they are xeroterms, nectar- or pollenconsumers, and their copulation also takes place on one of the flowers of the steppe-community. Here, many times the animal favours determined species. In the Carpathian basin these species reach their highest density in the forest-steppe zone.

The situation is more complex in the case of the Cerambycides living in the pliant-stalked plants.

The Dorcadions can be collected in masses at the top plane of the dam, at the sections of Southern exposition. The *Phytoecia scutellata* FABR. is by far more rare. Only a total of two individuals were found within the period of 10 years. It is of interest that the *Calamobius* phylum Rossi and the *Theophilea cylindricollis* PIC., the two steppe-species being under protection and held earlier as being explicity xeroterms, were found to swarm rather at the cooler and more humid dam bases. This same shift can also be observed in the case of a few highly tolerant and wide-spread species, like the *Agapanthia Dahli* RICHT., *Phytoecia pustulata* SCHRANK, *Plagionotus floralis* PALL., etc.

At the dam-verge of the flood-plain forests, the *Oberea euphorbiae* GERM. characteristic of the marshy meadows and — probably due to the large quantities of the nutriment plants — the *Phytoecia coerulescens* occur in masses. These are the two species which can regularly be found also within the willowy-zone. The rest of the long-horned beetles developing in the softstalked plants mainly show seasonal spread. Their long-lasting settlement can only be counted upon after two or three years without floods (depending on the change of generation).

MOLNÁR, GY.:

Niche studies on the stock of starlings *(Sturnus vulgaris)* at the flood-plain forest communities

The number of nesting starling pairs was calculated between 1978—1981 near Szeged at the section of the Tisza flood-plain. The tree-sparrow also nests at the area in hollows, the alimentary area of which is also similar to that of the starling. The question arose whether there is any competition between the two species? Attempt was made to find an answer to this from the data applying a four-dimensional analysis. From the data of the dimensions, the niche-width and the niche-overlapping was calculated, the latter was also controlled by computer method. Despite the significant overlapping, there is probably no competition between the two species.

KOVÁCS, S.:

The occurrence of a water-moth *(Acentropus niveus* OLIV.*)* at the environs of Mártély

(The paper of the lecture will be published in the 1984 volume of the Tiscia.)

MOLNÁR, GY.:
Niche studies in the stock of starlings *(Sturnus vulgaris)*

The number of the nesting starling pairs was calculated between 1978—1981 at a designated section of the Tisza flood-plain. During the course of the observations, the question arose whether there is any competition regarding habit between the starling and the tree-sparrow, also nesting in hollows. Calculations were accomplished in the case of both species in four niche-dimensions: diameter of hollow opening; height of hollow; volume of animal nutriment; and the time passing between feedings. The niche width and the niche overlapping were calculated from the data, the latter was also controlled with the help of a method using computer. Despite the significant overlapping, no competition was found between the two species. The environmental capacity of the flood-plain forest is so great that the populations of the two species are kept well here.

KOMENDAR, W. I.:
The vegetation at the White Tisza-valley

(The paper of the lecture will be published in the 1984 volume of the Tiscia.)

FODOR, I.:
The floristic and geobotanic relations of the Black Tisza-valley

(The paper of the lecture will be published in the 1984 volume of the Tiscia.)

PUJIN VLASTA, RATAJAC RUŽICA and DJUKIČ NADA:
Zooplankton and bottom fauna composition and dynamics of the Lower Tisza section

(The paper of the lecture will be published in the 1984 volume of the Tiscia.)

BUDAKOV LJILJANA and MALETIN, S.:
The Bloch body length and weight increase dynamics of the *Esox lucius* L., *Blicca bjoerkna* L. and *Carassius auratus gibelio* at the Tisza river

(The paper of the lecture will be published in the 1984 volume of the Tiscia.)

MIKES, M.:
The digging activity of the mole *(Talpa europaea L.)* at the Tisza dam

The mole is the characteristic therobiont representative of the insectivore. Due to its characteristic way of life, it has significant role in the soil of the various biotopes (forest, field, plough-land, and grazing-land), bot of thè lowland and the hill-country. Its habit of feeding stands in direct relationship with its digging activity, forming newer mole-hills whilst expanding its underground passages.

The activity of the mole colony was mapped and the obtained data were processed statistically. The circumference lines of the mole colonies, the individual area measurements, as well as the digging activity in relation to time and space were followed with attention within the range of the study.

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SUMMARY OF THE RESULTS IN TISZA-RESEARCH OBTAINED DURING THE YEAR 1982

GY. CSIZMAZIA

The complex studying of the Environment Protection Area at Mártély-Körtvélyes had been accomplished by our study group in 1981. At the present time, after the first year of the 2×3 years research programme of the Alpár basin, we are in possession of data and hypotheses, which shall be reported on by our coworkers. The Tisza-research having its 30th jubilee this year continued its studies also in the current year joined to the 15-years perspective topic of the Hungarian Academy of Sciences entitled "Man and the protection of his natural environment", within the frame of the subject approved by the Hungarian Academy of Sciences: "Complex investigations of the Tisza river and its flood-plain, with regard to the river barrages and the nature conservancy areas". The year's areas where the studies were of the most important point extended to the Alpár basin, the region of Tőserdő and the range of the storage tank at Kisköre. The plan of research regarding Bodrogzug was prepared at the end of 1982, which study was started in 1983 in accordance with the research contract made with the National Board of Environment- and Nature Conservancy.

The Tisza-research activity of the Ukranian (CCCP) researchers has also been started. Fauna and flora investigations are being carried out at the Departments of Zoology and Botany of the State University in Uzhorod, under the leaderthip of Professors V. I. KOMENDAR, S. FODOR and I. I. TURJANYIR. In the Autumn of 1á82, on the occasion of my Sub-Carpathian study-tour, the edition of a joint publication related to the nature conservation of the Tisza had been started together with Professor TURJANYIN.

The researchers from Novi Sad led by Professors M. MIKES and P. VLASZTA have also accomplished intensive studies in 1982.

In the fore-goings, a complex review is given on the investigations carried out at the Hungarian section of the Tisza river.

I. Studies in progress at the Alpár environs: Throughout the year, the oxygen-content of the water in the dead-Tisza at Lakitelek was above 6 mg/l) the oxygen-saturation was a minimum of 763. The low dissolved oxygen (3,9 mg/lr measured at the sampling site at the research house was accompanied by rathes high amount of organic matter. It is interesting that the ratio of ondatra was the highest here (1 hectare — 12 ind.). The total salinity at the backwater was also rathe, constant (490—580 mg/l in the Spring — Autumn interval). The calciumion war always of vertical and horizontal value, which could not be stated of magnesium. The backwater's phosphorus- and nitrate-contents were rather low. According to the COMECON classification, the water quality was "clear water, Ist class". By now, the backwater at Lakitelek is a holiday resort and angling water; attempts must be made to entirely preserve and realize, respectively, the quality of the water and also our environment protection objectives.

The bacteriological investigations at the Alpár backwater have demonstrated the seasonal fluctuation of the coliform and faecal coliform bacteria. The seasonal dynamic study of the algal communities has proved the relatedness of the algal communities here with the algal world of the sodic waters. Euglena sanguinea algal bloom appeared at Bokros. There were two maximums of zooplankton in May and September at the Alpár backwater (Protozoa, Rotatoria, Entomostraca).

The alphamesosaprobe organisms were dominant in Summer.

The studies on the Syrphidae and Culicidae species from the area of the storage tank to be established showed interesting results. Here, the Diptera fauna was found to be more variant. *Aedes caspius* PALL. larvae live in the seasonal waters of the stagnant pools becoming sofified, and *Culex modestus* FIC. larvae live in the backwaters. The larvae of *Aedes vexans* MEIG live in the seasonal, but not sodic waters. These three species cause the main mosquito-harm at the area. At the shrubby regions the *Anopheles maculipennis* MEIG is also observable.

The malacological investigations at the area in 1982 involved the snail communities: these belong to the continental Siberian-Asian fauna-society.

The ornithological investigations of the Nagy Lake and Meadow at Tiszaalpár registered 47 nesting, 14 locally feeding and 45 over-flying species. 126 pairs of different heron types hatched eggs at the thick reedy, marsh-willowy heron colonies (night heron, small heron, squacco heron, red heron, common heron, big heron). 86 pairs of wild terns nested in the waterlily-stratiotes marsh, together with mire-crows. It is an important conclusion that the avifauna recalls the picture of the marsh-world of the centuries old Tisza overflows — all this at the boundary of the Tőserdő Reserve of the Kiskunság National Park — rare nesting and over-flying species live here — therefore, it seems expedient to attach these parts also to the protected area and to leave these out from the works on the river barrage.

The faunistic survey of the small mammals was accomplished at the Alpár meadow in the agricultural civilization and the *Salicetum albae-fragilis* grove. The occurrence of five species was proved in 1982. The studies aim at the interrelationships of the intra- and interspecific competition, and bring light to the predational aliment-chain relations in the ecosystem.

II. study area: Tőserdő. The 1982 research results of the competition topic entitled "The comparative complex hydrobiological, biocenological and synecological seasonal dynamics of the nature conservancy area and environment of the Kiskunság National Park at Tőserdő" could be sketched in brief as follows.

As basic study, the dynamics of the salt-household were determined in the waters belonging here. 286 algal taxa were demonstrated from the aquatic microorganisms, the seasonal fluctuation showed a maximum in the Euglenophyton and Chrysophyta groups.

The water producing macrophytocenoses at the marshland were formed in 80% by the mosaic-complexes of the contiguous *Nymphaaetum, Trapetum, Hydrochari-Stratiotetum* (patchy *Hottonia* stand).

The bacteriological studies served the purpose of the environment protection of the Tőserdő holiday resort. *Salmonella* was not demonstrable in the backwater. Both in qualitative and quantitative respect, the Rotatoria components dominated in 60% in the zooplankton of the Tőserdő backwater. These were followed by the Protozoa in 25%, and then by the Entomostraca in 15%. The first group revealed correlation partially with the culmination points of the thallus-bodied bacteria number and algal production, respectively. The most frequent taxa were the *Arcella stellata, Centropyxis aculeata, Brachionus* sp. and *Keratella* species.

The temperature rise of the backwater at the beginning of Summer is also accompanied by the increase in the amount of zooplankton, which shows correlation with the mas appearance of the schools of young fish.

From these vertebrates the 1982 data manifest 34% decrease in species according to the malacological studies, compared to the results of earlier investigations.

Among the consumers of the backwater the praedational relations of the ichtiofauna were studied. The largest was the Cyprinidae family with 12 species. Here the carnivorous fish species are low in number — compared to other Tisza backwaters — with the exception of the numerous *Amiurus nebulosus*. Data collection related to mammology extended to the populations of the bats *(Nyctalus noctula)* living in the hollows of poplar and the ondatra populations at the backwater *(Ondatra zibethica)*. The bird fauna in the ligament-forest near the Tőserdő backwater is rather rich. The nesting of the black woodpecker and the grey laughing-bird is the great ornithological value of this area. It could be determined that — unfortunately — the life activities of the birds nesting in forests — only rarely detectable in the lowlands — are greatly disturbed by the many tourists in Summer and at week-ends. Nature conservancy would have further tasks in this regard.

The III. stressed study area was the storage tank at Kisköre. The water quality of the storage tank in 1982 showed a more favourable picture compared to the previous years. On the basis of the dissolved oxygen-content values, the chemical oxygen demand, as well as the dissolved mineral substances, it proved to be of COMECON Ist class. On the contrary, the values of the suspended matter measured during the course of floods and the total amount of iron made the water of IIIrd class in certain cases. Among the plant nutrient solutions important from the viewpoint of eutrophization, abundant amounts of phosphorus and nitrogen were registered. The inundation with Tisza water of the Sarudi basin (rinsing canal No. V.) was favourably ensured by the velocity relations. This and the fluctuations caused by wind significantly pressed back the process of bentonic eutrophization. The considerable repression of the dense macrovegetation characteristic of the past years was also firstly a consequence of the changed conditions of the water course. The results of the studies all the more allow the conclusion that although the Tisza water flows continuously into the storage tank, there is a possibility for us to determine: the quality of the water wished to be stored; the time the possibly "decomposed" water is wished to be changed; and the type of water with which to fill up the storage tank again. However, the storage of "bad" water, the surplus drainage of "good quality" water and even the unnecessary derangement of the "settled" water quality state in the storage tank are also possible, if merely on the basis of technical reasons we specify various modes of function and carry out inadequately prepared technical interventions, or changes in water level.

The 1982 studies on the phytoplankton communities of the storage tank also proved the good functioning of the rinsing canal established between the Tisza and the storage tank, which hinders the development of high algal number. The large openwater areas of the banked up Tisza and the storage tank were suitable for recreational purposes in the year.

The studies on the mineral substance quantities regarding reed-grass vegetation and litoral vegetation significantly indicate the extremely high iron-, manganese-, aluminium- and zinc-contents in the water of the storage tank.

The bacteriological studies are interesting; we have been successful in cultivating enteral pathogenic bacteria *(Salmonèlla derby, Salmonella brandenburg)* from the segment of Kisköre, but not from the segment of Tiszafüred. The bacteriological invrstigations at the Eger brook showed gradually increasing bacteriological pollution in the segment at Almár. More and more week-end houses are being built at the area, the hygienic problems of which are unsolved. The *Salmonella infantis, Salmonella give, Salmonella meleagridis, Salmonella bovis-morbificany,* and *Salmonella panama* have been cultivated from the Eger brook.

Important determinations have been made concerning the development of the fish stock at the Kisköre storage tank. As the consequence of the silting up of the channel, the species roeing at the bottom all the more lose their spawning ground, therefore the individuals reaching sexual maturity migrate from this river section *(Acipenser ruthenus, Barbus barbus)*. With the decrease in the amount of rolled alluvium, those species which mainly select their nutriment from this are able to obtain it less easily, therefore their stock becomes suppressed *(Aspro zingel, Aspro streber)*. The barrage keeps back regularly the Spring overflows, and the easily warming up shallow water creates favourable conditions for the multiplication of the emerging limnophyl species, ensuring in such a way the adequate supply of the brood. However, a significant proportion of the progeny becomes victim to the lowering of the water in Autumn, because due to the unorganized state of the area, they are perforced outside on the navvy pits and the shallow-watered plains. The loss should be reduced by the building of newer drain-canals. It could be determined of the fish stock at the Kisköre region that while the carp belonged to the upper region of the state-tract before the damming up of the water, today it belongs to the lower region.

The analysis of the nesting bird communities at the storage tank had started in 1982, the preparation of the bird map is in progress and shall be finished in two years time.

Finally, after reviewing the previous three well-circumscribed areas where the research activities are being carried out more or less complexely, let us survey the punctiform researches going on "dispersedly" at other sections of the Tisza river.

Further data were collected on the biological water quality of the Tisza between Tokaj and Tiszafüred, with emphasise on the investigations of the oxygen circulation at the Sajó. The bacteriological studies of the district waters at the Middle Tisza-Section were carried out in two areas: Körösér and the dead-Tisza at Tiszakécske. It has been proved that the majority of the allochton organic matter contaminations is becoming mineralized through biological process with the help of bacteria, therefore their role is important in the process of natural purification.

The seasonal studies as well as the disclosure of the environmental-biological background of the algal vegetation at the Eastern Main Canal and nearby Tisza section were further continued.

The *Daphnia* testing of the Tisza section at Szolnok county and its district waters, as well as of the drinking water of Szolnok city shows encouraging results. The results of each *Daphnia* test of the Tisza longitudinal segment study were negative. From this, the unrefined water before the Szolnok Water Works should be emphasized, where 5.1% of the samples was positive, as should also be the drinking water obtained from the surface Water Works — supplying the drinking water for the city and its environs — where 24.3% of the samples also showed positivity. Compared to the results of the recent years, this is an extremely favourable ratio, both in the case of unrefined and drinking water. The explanation to this is seen in the fact that on one part, the water quality of the Tisza has improved, on the other part, the processing techniques of the surface waters have also considerably improved.

The cenological data and the studies on the grassy areas of the water plant vegetation at the river section in the environs of the water storage tank (till Tisza-aranyos) have been supplemented. It has been determined that the most important task of the future is the maintenance of the richness in species of the natural grass-plots. From the viewpoint of forage, the abundance in species of the biotic grass-plots found at the Tisza flood-plain areas has such balanced and favourable mineral substance-content, which cannot be experienced in the case of the vegetation at the flood-plain areas of other rivers in Hungary. The decrease in mineral substance-content in the case of the artificial grass — which are well known to be poor in species — mostly results the catastrophic deterioration in quality of the pasture.

The studies on the honey-bee population were carried out in the region of Tiszasziget as well as Vásárosnamény and Tarpa.

In 1982 the hatching stock of sand martins at the Middle Tisza Nature Conservancy Area was about 1910 pairs between the 397 and 288 riv. km section. The large scale decrease in the number of sand martins *(Riparia riparia)* compared to the previous years was caused by the water conservancy bank-safeguarding works carried out in the area of Tiszakécske. As the consequence of this, the nest colonies of the sand martins may probably have increased at the areas falling North from Szolnok.

The studies came to an end in 1982 regrading the topic of the aliment and energy demand of the ... at Tiszavölgy. According to the determinations, one hatching pair of the nesting in the ... Sasér and Mártély Nature Conservancy Area, as well as its progeny counted averagely for two individuals. consume 288 kg fish in the interval between March and October. The study is destined for serving with concrete data to the realistic judgement of the damage caused by the birds experienced in the nearby fish-hatchery at Szeged-Fehértó.

Finally, I should like to mention that according to my opinion it would not be without interest to review — if only briefly — the research areas of the year 1982, since this is when we could jointly evidence the enormous and far-reaching activities being carried out by our co-workers. This work, from water chemistry throughout botanic relations to the vertebrates, is unique not only in the relation of the Hungarian, but also in that of the foreign researches on rivers. The attempt regarding the complex coordination of the research subjects on the Tisza river has been achieved in the volume on Körtvélyes of the Tiscia. We hope that this effort will prevail more increasedly with the concluding of the next plan period related to Alpár and Tőserdő.

Following the beginning "illusory" monographic objectives, the Tisza-research has found the resultful, and — according to the possibilities — one of the best means of concrntrating the intellectual scientific products.

Finally, I should like to call our attention to another important task. The relattionship between the Tisza and environment protection is two-faced. On one side is the protection of the condition, living world, and water quality of the surface waters (aquatic environment protection); on the other side is the role of the river in the formation of the environmentalbiological fundamentals of our surroundings. Many negative examples could be listed from both fields. The "regulation" of living waters;

the straightening of water-course channels; their lining with concrete together with their living world; the stoning of river banks; the dredging of the bottom sediment together with the living world there; the eradication of forests at flood-areas; the colonization of herbivorous fish into backwaters; the artificial alteration of the depth and drift of the water; the entering of sewage — can all not be done with impunity, without the knowledge on, and without taking into account the ecological demands of the living creatures.

Today the environs of the Tisza is formed rfom teh complicated network of the artificial and natural factors, and in general, the proportion of these two changes according to the purposes of man. And where the value of the Tisza environs is determined by natural formations — according to the human standards — the demands of these natural formations should be studied before each intervention, which — it could be said — are biloogical demands in every case. Therefore, besides the whatever high scientific levelled publications and lectures on Tisza-research — intended for everybody, yet not addressed to anyboky — our co-workers must also find the concrete nature conservancy questions from their own special fields of research, and elaborating these — in the interest of environment protection — attempts should also be made regarding effectuation from the profile of their familiarizing, acceptance and scientific popularization.

It should be an important promoter of our efficiency to also succeed in getting thr nature- and environment protection questions regarding the Tisza into the value judgement of the designing smaller teams and our society — as an integral part.

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